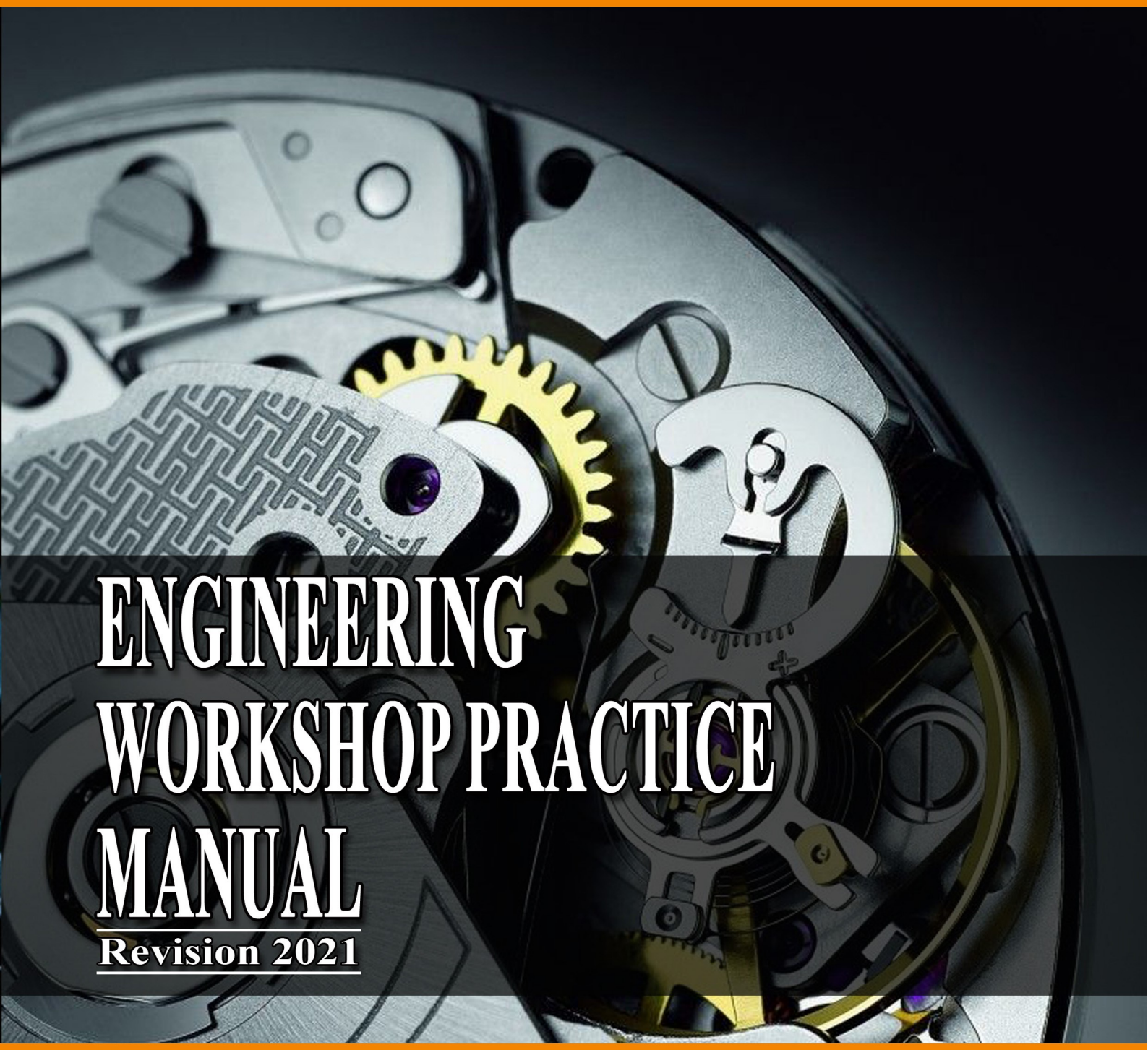

ENGINEERING WORKSHOP PRACTICE MANUAL

Revision 2021

Govt. of Kerala
Department of Technical Education
State Institute of Technical Teachers' Training & Research
(SITTTR), Kalamassery

ENGINEERING WORKSHOP PRACTICE MANUAL

Outcome Based Revision 2021

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PREFACE

This manual is prepared for the first and second semester diploma students in polytechnics under the Department of Technical Education, Kerala. It helps the student to get an overall awareness about the course and its design.

The General workshop holds an important role in nurturing the work skill of the student. It imparts the knowhow of various process and practices in manufacturing and production. It makes them aware on the safety precautions to be taken, usage of various tools, instruments & machines and also to perform engineering works with supportive drawings and figures.

The experience and practice in the Mechanical workshop will enhance the ability of the students to execute the works based on the drawings and specifications in various mechanical engineering trades like Carpentry, Sheet metal, Fitting, Welding and in Electrical engineering-electrical house wiring & Soldering.

This manual will guide the students to get in to the basics and importance of practical work in engineering stream and also to understand the prescribed learning outcomes. In addition to this, demonstration and practice in advanced machines and processes in various trades are also recommended.

Course Material Development Committee
ENGINEERING WORKSHOP PRACTICE MANUAL – For Diploma in Engineering
(Outcome Based Revision-2021)

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Program : **Diploma in Engineering and Technology**	
Course Code : **2009**	Course Title: **Engineering Workshop Practice**
Semester : **1 & 2**	Credits: **1.5**
Course Category: **Engineering Science**	
Periods per week: **3** **(L: 0 T: 0 P: 3)**	Periods per semester: **45 + 45**

Course Objectives:

- To familiarize safety precautions practiced in the workplace.
- To prepare drawings models for fabrication.
- To identify various measuring, marking, holding, striking, and cutting tools & equipment.
- To practice electrical wiring and soldering.
- To prepare a drawing of models for fabrication.
- To operate machines, power tools and equipment safely.

Course Outcomes:

On completion of the course, the student will be able to:

COs	Description	Duration (Hours)	Cognitive Level
CO1	Identify the safety precautions, tools and devices required to make carpentry joints	18	Applying
CO2	Make use of various tools, machines, instruments and power tools used in the Fitting shop to make fitting joints	18	Applying
CO3	Make use of various tools, machines, instruments and power tools used in the Welding shop to make welding joint.	18	Applying
CO4	Utilize different sheet metal tools and measuring instruments to make sheet metal joints.	18	Applying
CO5	Make use of various tools and accessories to practice electrical wiring, motor connection and soldering	18	Applying

CO – PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

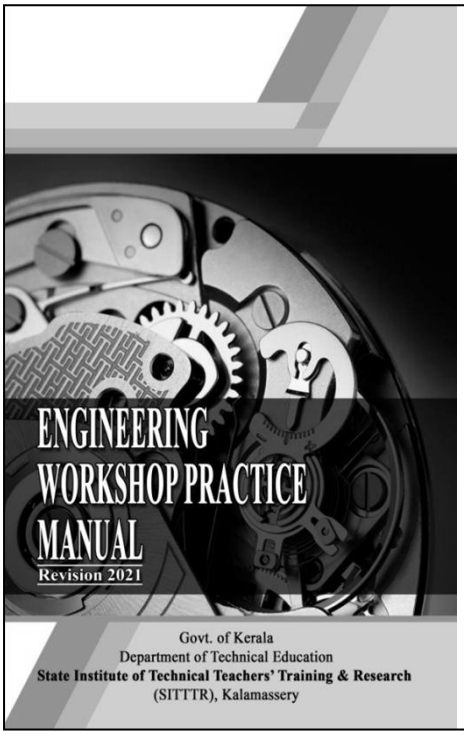


TABLE OF CONTENTS

Safety Precautions

Personal Safety

- Wear tight clothes; beware of hanging hair, ties, clothing, scarves or belts getting caught.
- Never enter the workshop without safety shoes.
- Do not use rings, watches etc. while working.
- Keep the workshop clean and tidy. The floor should be free from oil and grease; the slippery floor is always dangerous.
- Wear goggles whenever there is danger of flying matter.
- Never attempt to measure the job in running.
- Always stand in respectful distance from moving and hanging parts.
- Practice cleanliness and orderliness in the shop.
- Do not run or play on the shop floor.
- Keep your body behind the sharp edges of cutting tools.
- Do not attempt to lift heavy articles without assistance.
- Never handle chips or shavings with bare hands; use special hooks, brushes etc.
- Never place sharp tools on the floor or at the edges of the workbench; keep them in proper place assigned for them.
- Be aware the cause of electrical hazards such as bare wires, poor earthing, return connections, wet floors etc.

Machine Safety

- Never operate the machine unless you have been properly instructed.
- Never work on the machine having unguarded moving parts.
- Stop the machine immediately, if it produces any unusual sounds.
- Before starting an operation, always check whether the work and cutting tools are secured fast.
- Never leave a machine when it is running.
- Never mount or remove the work, replace tools, clean or lubricate the machine, or remove the cover while the machine is running.
- Do not run the machine in an incorrect speed.
- Do not talk or disturb others while they are operating a machine.

Job Safety

- Use right tools for right job.
- Use metal strips to hold work pieces like Brass or Aluminum, to avoid gripping marks on the finished surface.
- Put oil lightly on finished jobs to avoid rust.
- Tools with loose fitting or broken handles shall not be used.
- To save the time and material, frequent checking has to be made.
- Do not mix the precision measuring instruments with other tools and equipments.
- Store inflammable materials like kerosene, turpentine etc. away from the shop.
- Be aware of the details and location of fire fighting devices like fire buckets, fire extinguishers etc. and first aid box in the workshop.

CARPENTRY

CARPENTRY

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Identify the safety precautions, tools and devices required to make carpentry joints**		
M1.01	i) Explain safety precautions ii) Demonstrate various wood working Tools/equipment and power tools.	3	Understanding
M1.02	Demonstrate various wood working process like Marking, Planning, Cutting, Chiseling, Grooving.	3	Understanding
M1.03	Construct a simple joint like open halved joint	12	Applying

Introduction

Carpentry involves cutting, shaping and fastening wood and other materials together to produce desired product. A carpenter may be involved in making furniture, a new building or repairing or re modelling an old one.

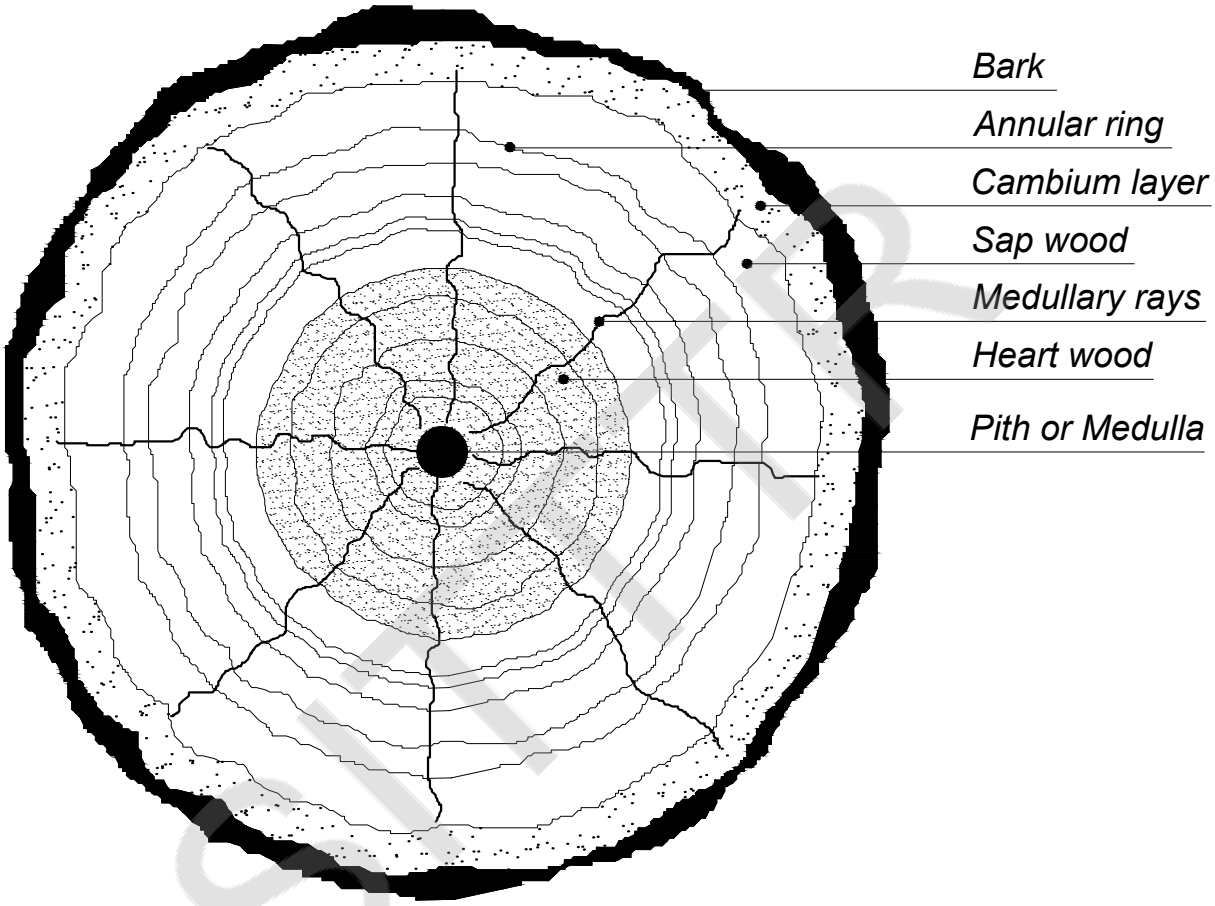
Timber

Timber is the basic materials used for any class of carpentry work. The term timber is applied to the trees which provide us with wood. Timber for commercial purpose is divided in to two classes.

1. Soft wood
2. Hard wood

1. Soft wood

Soft wood is obtained from trees having needle leaves. It is light in weight and color, and has straight fibers. The annual rings are visible. It has good tensile strength.



CROSS SECTION OF A TIMBER

2. Hard wood

Hard wood is obtained from trees having broad leaves. The annual rings are not visible and its fibers are close and compact. It is heavier than soft wood and is difficult to work on. Teak and mango trees are examples.

The cross section of a timber is shown in figure. It has the following parts.

Structure of a Tree

a. Pith or medulla

The centre of the trunk is called the pith or medulla and is often soft. It is the remains of the original sapling.

b. Heart Wood

The wood around and near the pith is known as heart wood. The heart wood contains resins, more durable, stronger and darker than softer sapwood. It resists decay, attack by insects and fungi, and is the most useful part of the tree from which to make furniture.

c. Sap Wood

The outer annular rings form the sap wood. This part of the wood is not very useful for engineering works. It is largely used as fuel. It is lighter in color and softer.

d. Annual Rings

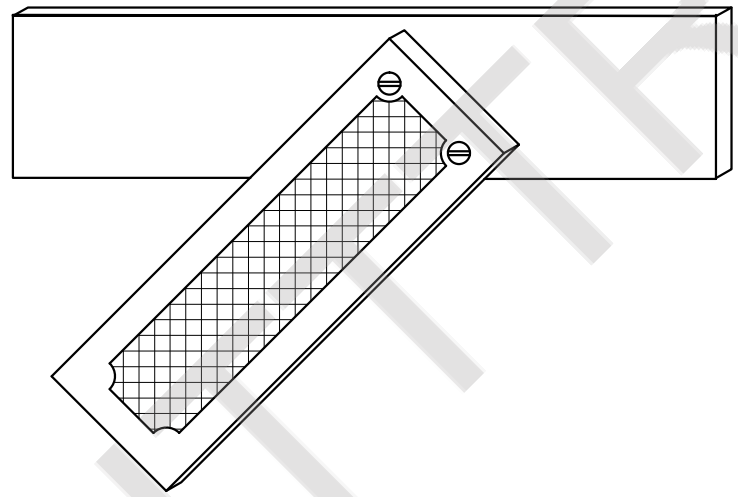
Each time the growth cycle is completed, the tree gains one or more growth ring, called annual ring. It is by counting these rings that the age of a tree can be determined, as each ring represents one year of growth.

e. Medullary Rays

The food is distributed to all parts of the trees by means of small cells which are called rays. These are more noticeable in the hard woods than in soft woods. This rays which run radial from the pith towards cambium layer, crossing the annual rings almost normally.

f. Cambium Layer

This layer is in between the sapwood and bark. As time passes the inner portion is gradually converted into sapwood.



MITRE SQUARE

g. Bark

It is the layer on the outer side of the trees. It protects the cambium layer of the tree from excessive heat and cold attack from insects and animals.

Carpentry Tools

In order to successfully work different forms to accurate shapes and dimensions, the wood worker must know the use of a large number of tools. The principal types which are manipulated by hand are described and illustrated below:

1. Marking and Measuring Tools

Marking and measuring tools have been developed in order to work truly and accurately. The most common are as follows:

a. Rules

Rules of various sizes and designs are used by wood workers for measuring and setting out dimensions.

b. Straight Edges

The straight edge is a machined flat piece made of wood or metal having truly straight and parallel edges. One of the longitudinal edges is generally made levelled. This is used to test the trueness of large surfaces and edges.

c. Mitre Square

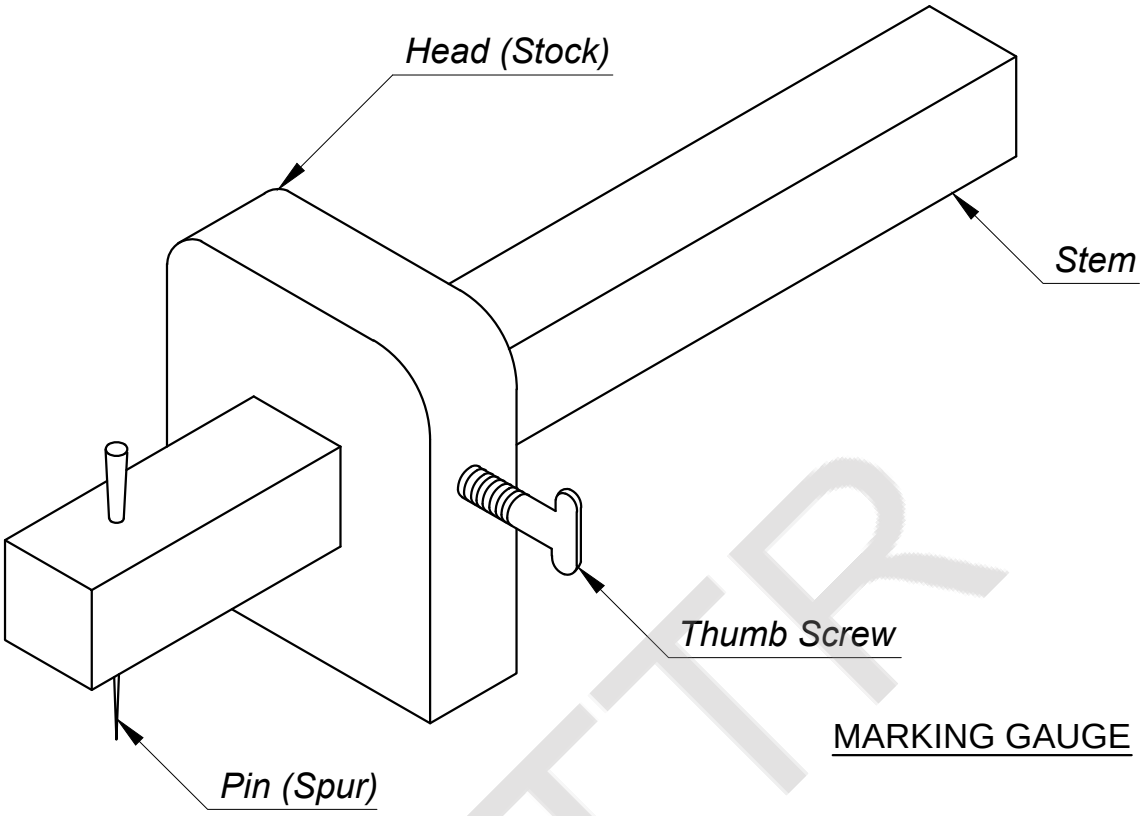
Mitre squares are used to measure an angle of 45°. Different sizes of mitre squares are available.

d. Try Square

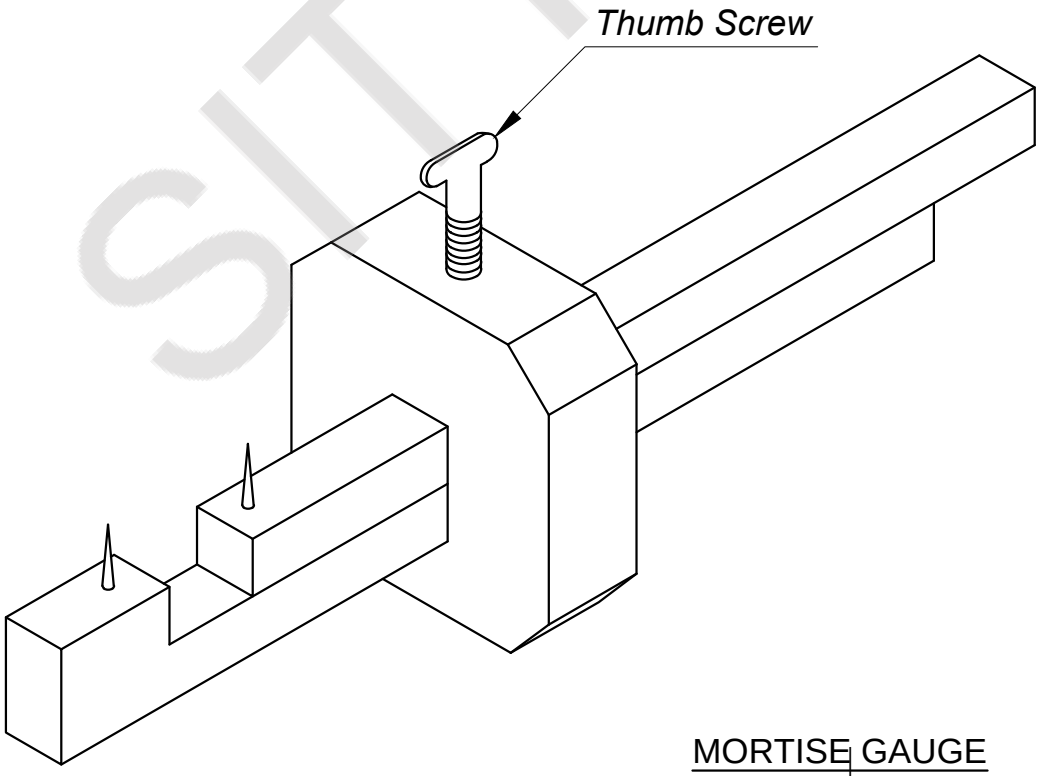
Try squares are used for marking and testing angles of 90°. It consists of hardened and tempered steel blade which is riveted in to a stock.

e. Bevel Square

It is similar to the try square but has a blade that may be swivelled to any angle from 0° to 180°. This tool is adjusted by releasing with a turn screw of suitable size in a machine screw running in a slot in the blade.



MARKING GAUGE



MORTISE GAUGE

f. Combination Square

A combination square is a tool used for multiple purposes in woodworking. It is composed of a ruler and one or more interchangeable heads that may be affixed to it. The most common head is the standard or square head which is used to lay out or check right and 45° angles.

g. Marking Knife

Marking knifes are used for converting the pencil lines to cut lines.

h. Gauges

Gauges are used to mark lines parallel to the edge of a piece of wood. It consists of a small stem sliding in stock. The stem carries on one or more steel marking pointers or a cutting knife. The stock is set to the desired distance from the steel pointer and fixed by the thumb screw.

1. Marking Gauge

The marking gauge has one marking point. It gives an accurate line parallel to a true edge.

2. Mortise Gauge

The mortise gauge has two marking points, one fixed near to the end of the stem and the other attached to a brass sling bar. These two teeth cut two parallel lines called mortise lines.

3. Cutting Gauge

The cutting has a cutting knife held in position by a wedge so that its projection may be varied for the depth of cut.

i. Wing Compass

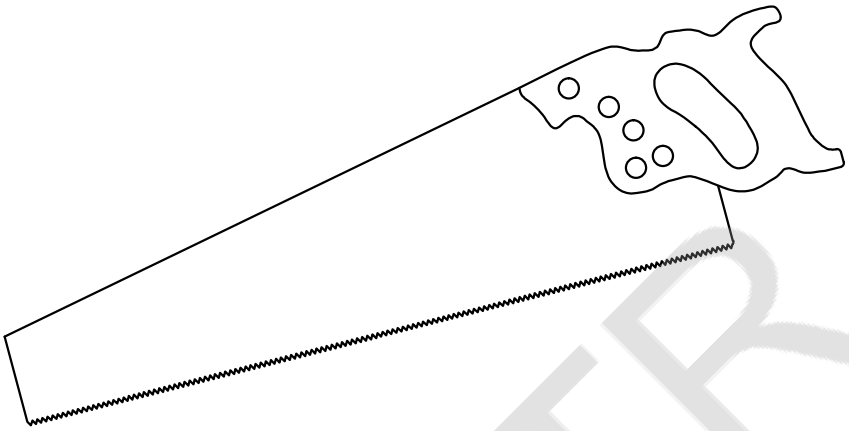
Wing compasses are composed of two finely pointed steel legs which are set to the desired position and held by setscrew and quadrant.

j. Spirit Level

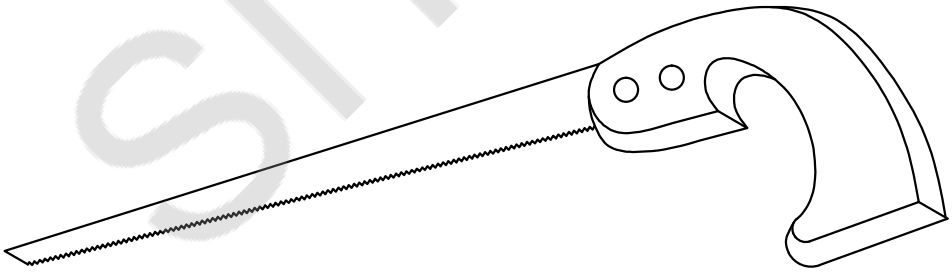
It is used for checking the horizontality of flat surfaces.

k. Plumb Bob

It is used for checking the verticality of surfaces.



RIP SAW



COMPASS SAW

Cutting Tools

Cutting tools includes saws, chisels, planes etc.

I. Saws

The saw is probably the most abused of woodworking tools, chiefly because inexperienced users force it too much. When cutting across the grain, a different action is required from the saw teeth than when ripping with the grain. Saws are generally specified by the length of its blades and pitch of the teeth.

a. Rip saw

Rip saw is the largest and coarsest of all saws. It is used for cutting along the grain in thick wood.

b. Cross cut saw

A cross cut saw is any saw designed for cutting wood perpendicular to the wood grain. Crosscut saws generally have smaller teeth than rip saws.

c. Panel saw

This is similar to cross cut saw having finer blade and teeth, used for cutting panels of doors or similar pieces.

d. Tenon saw or back saw

This saw is mostly used for cross-cutting when a finer and more accurate finish is required. The blade being very thin is reinforced with a rigid steel back.

e. Bow saw

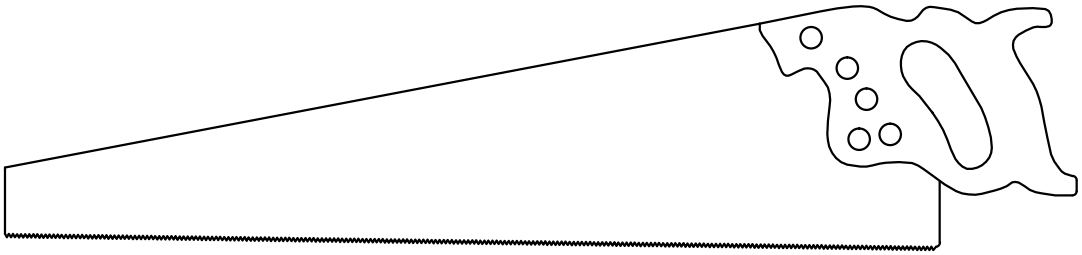
This saw has a narrow blade on a wooden frame of the shape of a bow. It is used to cut along sharp curves.

f. Compass saw

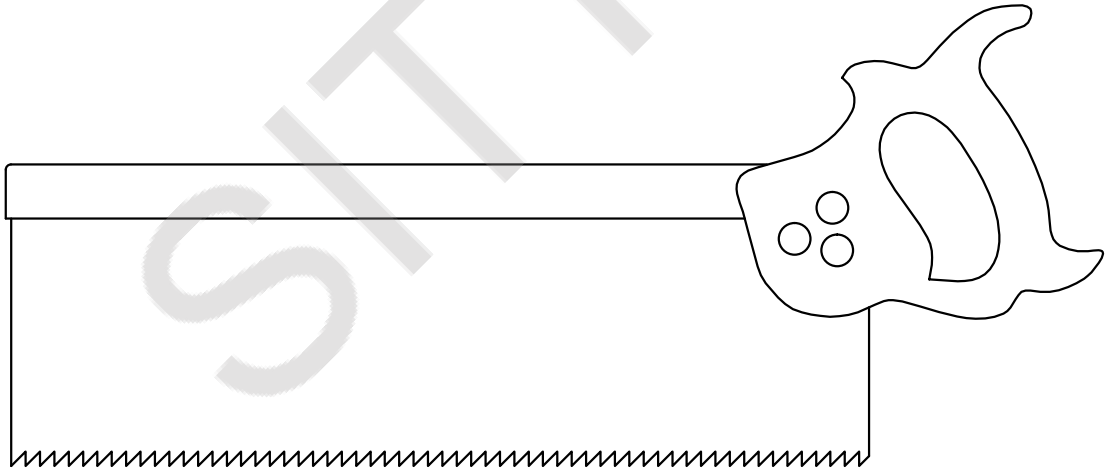
The compass saw is used for sawing small curves in confined spaces and has a narrow tempering blade.

g. Keyhole saw

This is the joiner's saw about 250mm long used for cutting keyholes or the starting of any interior cuts.



PANEL / HAND SAW



TENON SAW

II. Chisels

Wood chisels most commonly in use include firmer chisels, either square or bevel edged, paring chisels and mortise chisels. They are usually specified by length and width of the blade.

a. Firmer Chisel

It is the most useful chisel for general purpose and may be used by hand pressure or mallet.

b. Bevelled edge firmer chisel

It is used for more delicate or fine work. They are useful for getting into corners where the ordinary chisel would be clumsy.

c. Paring chisel

Both firmer and bevelled edge chisels when they are made with long thin blades, are known as paring chisels. This is used for shaping and preparing the surfaces of wood and is manipulated by the hands.

d. Mortise chisel

The mortise chisel is its name indicates is used for chopping out mortises.

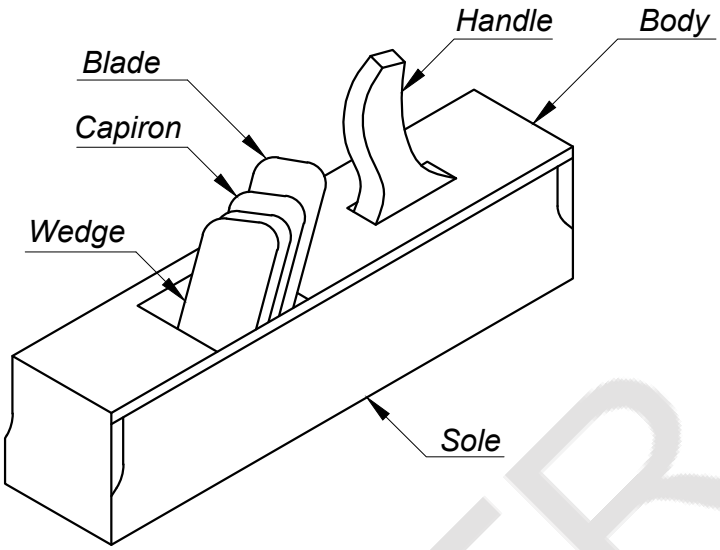
These chisels are designated to withstand heavy work.

e. Gouge Chisels

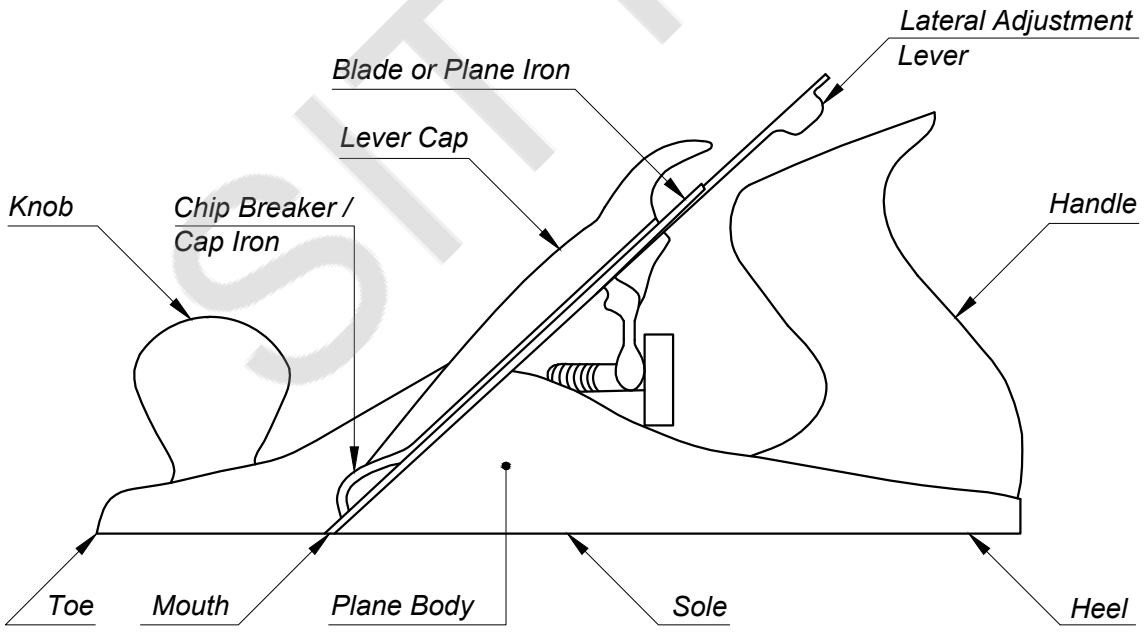
A gouge chisel serves to carve small pieces of the material, particularly concave surfaces. A gouge typically has a 'U'- shaped cross section.

III. Planing Tools

The plane can be likened to the chisel fastened in to a block of metal or wood and its blade cuts exactly like a wide chisel. The planes in general use, are the jack, trying, and smoothing planes, and are known as bench planes. Besides the bench planes are other planes which are used for special work.



WOODEN JACK PLANE



METAL JACK PLANE

a. Jack plane

This is the commonly used plane for the first truing up of a piece of wood. It consists of a block of wood in to which the blade is fixed by a wooden wedge. The blade is set at an angle of 45° to the sole. On the cutting blade, another blade is fixed; called cap iron or back iron.

b. Trying plane

It is a finishing plane and is set with a very fine cut, used for producing a true surface as possible as the smoothing plane does.

c. Smoothing plane

This plane is similar in action to a jack plane except that it is set to a much thinner planning, after the use of a jack plane.

d. Rebate plane

The rebate is a recess along the edge of a piece of wood; this forms a ledge which is used for position glass in frame and doors. It is used sinking one surface below another, and shouldering one piece in to another.

e. Plough plane

The plough plane is used to cut grooves along the grains. A set of 8 to 9 interchangeable blades are supplied with the plane, varying in width from 3mm to 15mm. Grooves up to 30mm depth can be made with this plane.

f. Router plane

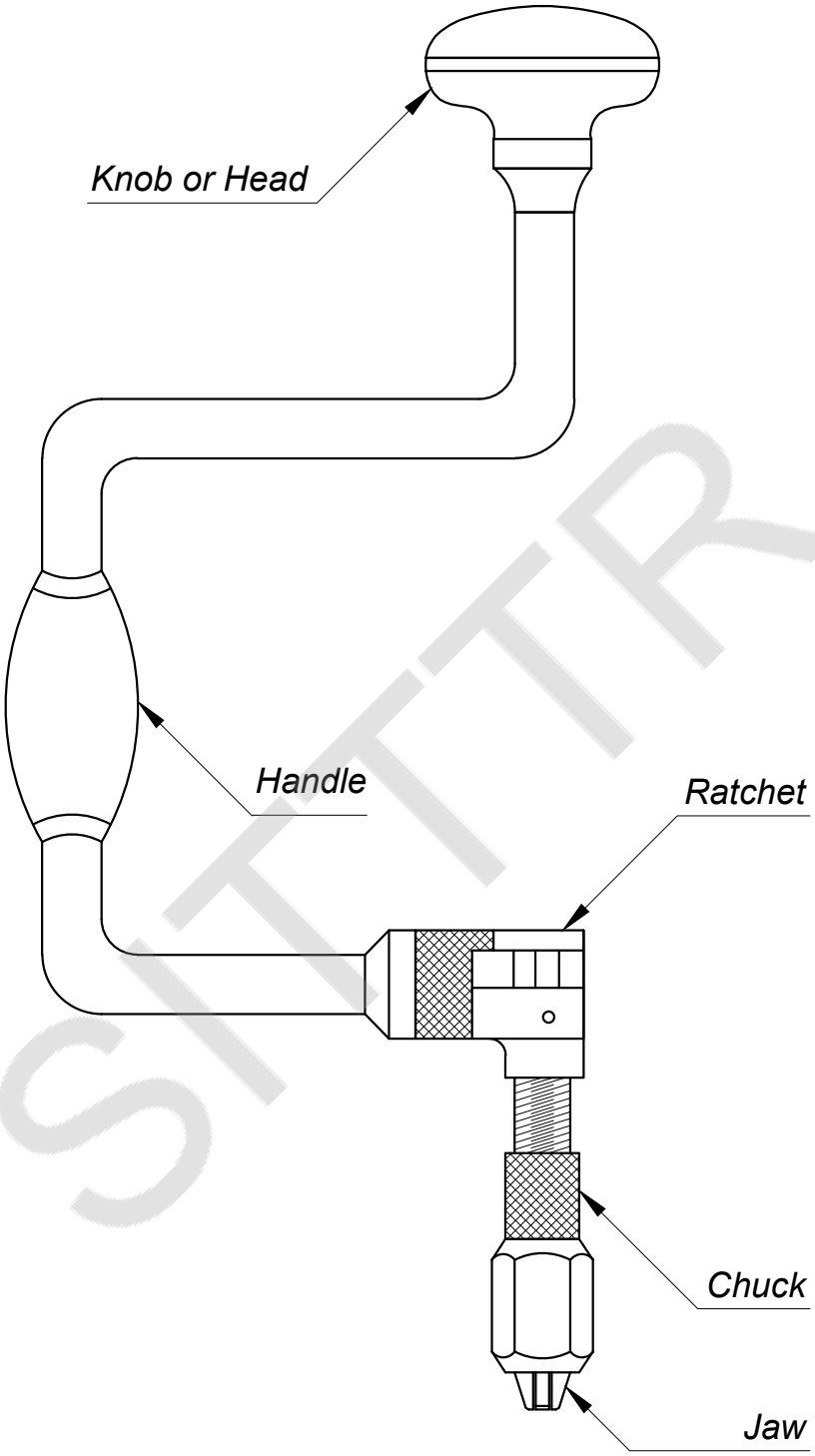
It is used for cleaning out and levelling the bottom of grooves or trenches to a constant depth.

g. Spokeshave

This is a double handled plane used for cleaning up or dressing curved surfaces.

h. Metal jack plane

Metal planes serve the same purposes as the wooden planes but facilitate a smoother operation and the better finish.



RATCHET BRACE

IV. BORING TOOLS

Boring tools are frequently necessary to make round holes in wood and they are selected according to the type and purpose of the hole. They include bradawl, gimlet, brace, bit and drill.

a. Bradawl and gimlet

These are hand operated tools and are used to bore small holes.

b. Brace

The brace is a tool used for holding and turning a bit for boring holes. It has two jaws which grip the specially shaped end of the bit. There are two types of braces in common use.

1. Ratchet brace

It is used to drill holes in restricted places. They are also used when the cut is particularly heavy and it is desirable to pull the handle through a quarter-turn only.

2. Wheel brace

It is used to hold round and parallel shanked drills. The tool is invaluable for cutting small hole, accurately and quickly.

c. Bit

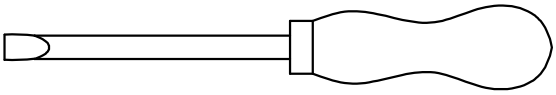
Most other forms of boring tools consist of bits. The most common used are follows.

1. Shell bit

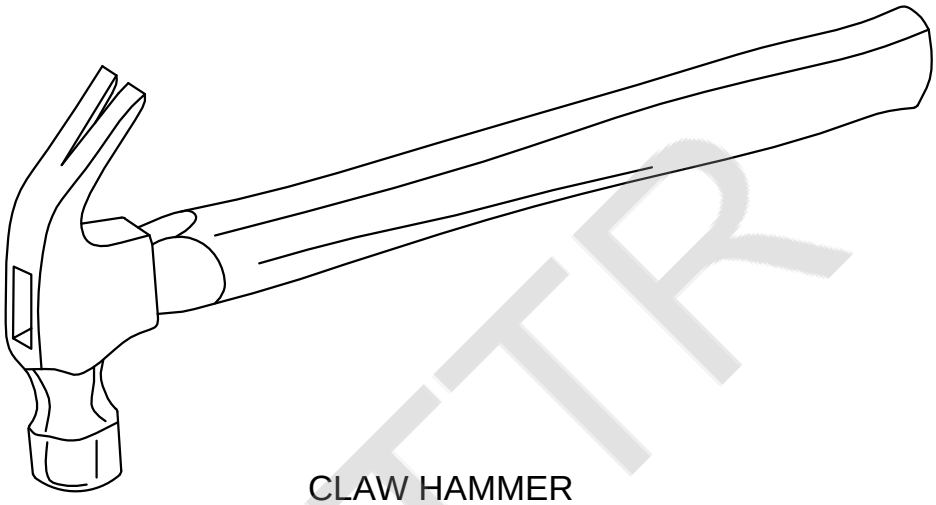
This long bit is from 300 to 900mm in length and from 6 to 12mm in diameter. Using a rest or a special attachment it is fed into work on the lathe, eg. For boring deep holes such as in lamp bases.

2. Forstner bit

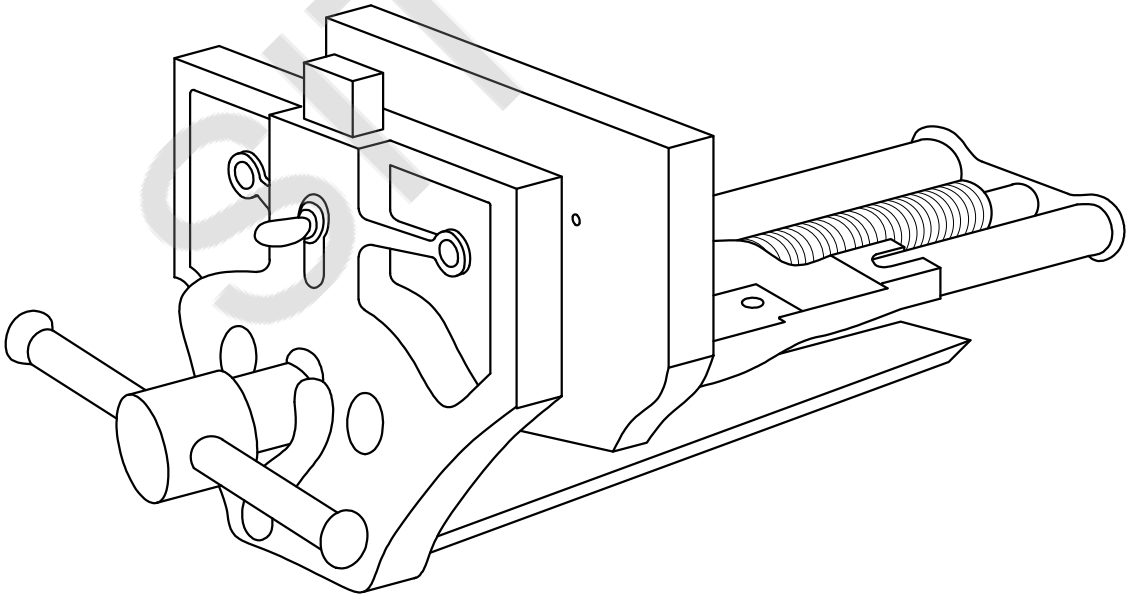
This has a shallow centre and a scribing ring inside which are two cutters. It bores a clean shallow hole which is unaffected by knots or awkward grain. It is not easily sharpened and should be stored carefully in a box. There are 24 sizes from 9 to 50mm.



BRADAWL



CLAW HAMMER



CARPENTER'S BENCH VICE

3. Counter sunk bit

It is used for counter sinking for screws. There are two types

- Snail horn bit – for use in soft woods
- Rose head bit – for use in hardwoods and mild steel

V. Striking tools

Striking tools include hammers and mallets.

a. Claw hammer

This is a hammer having steel head and wooden handle. The flat face of the head is used to drive nails and the claw portion for extracting nails out of the wood.

b. Mallet

This is a wood headed hammer of round or rectangular cross section. The striking face is made flat to the work. Mallet is used to give light blows to the cutting tools and has wooden handle.

6. Holding devices

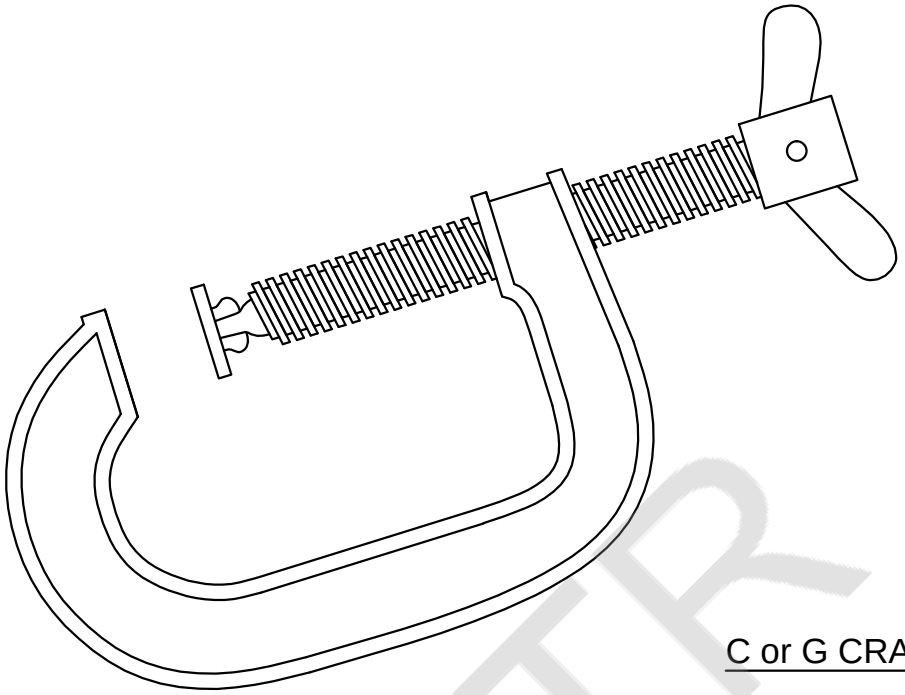
To enable the wood worker to cut his wood accurately, it must be held steady. There are many types of holding devices according to the nature of work to be done. They are as follows:

a. Carpenter's bench vice

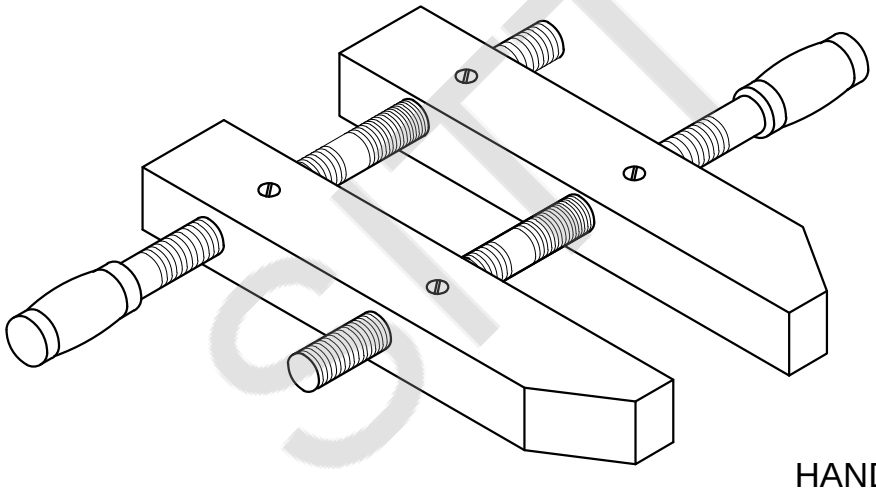
It consists of a jaw fixed on the table side and a movable jaw kept in position by means of a screw and a handle. The body of vice is made of cast iron or steel. The jaws are lined with hard wood which can be renewed when it is damaged. The screw works inside a fixed half nut which can be engaged or disengaged by operating the lever. By pulling the lever the nut is disengaged from the screw allowing the jaw to move fast. When the lever is released, the nut engages and screwing action is obtained.

b. Bench stop

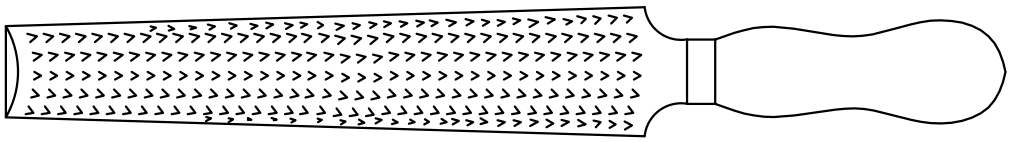
The bench stop is simply a block of wood projecting over the top surface of the bench. This is used to prevent the wood from moving forward when being planned.



C or G CRAMP



HAND SCREW CLAMP



RASPCUT FILE

c. Sash (bar) cramp

This is made up of a bar of steel, two jaws and a screw. The work is clamped between jaws by rotating the screw using handle. It is used for clamping glued pieces tightly or holding the work pieces of large size together for various operations.

d. C or G cramp

It consists of a malleable iron frame that can be swivelled and a steel screw to which is fitted a thumbscrew, used to hold small work pieces.

e. Bench hold fast

The bench hold fast is made up of steel and is used to hold the work piece on the table, while doing the cutting or similar operations.

f. Hand screw

It is used for clamping or holding pieces tightly for various carpentry operations or pasting sheets together when a wider area of pressure is required than a G-cramp.

7. Miscellaneous tools

There are number of tools other than the types explained above, which are used in carpentry shops to meet the requirements. The frequently used tools of this group are given below.

a. Rasp cut file

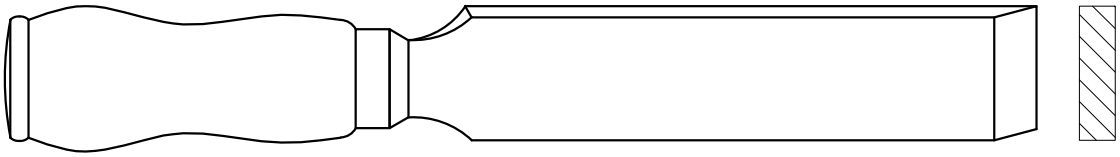
Rasp is a rough file used to remove wood from the surface, corners etc., resting very rough surface. Ordinary files are used to smooth such surfaces.

b. Scrapers

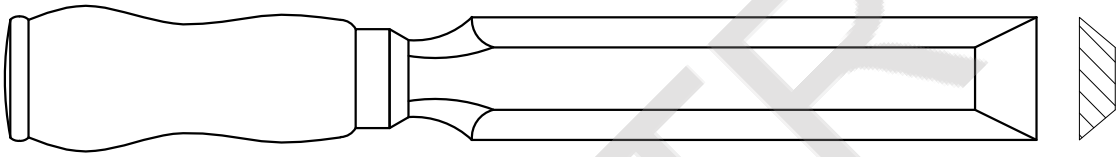
Scrapers are tools consist of a piece of thin steel, hardened and tempered with burr. Scraping means removal of a very thin layer of wood similar to shaving.

c. Sand paper

This is a thick paper coated with sharp edged sand or glass particles of fine type on one side of it. When the sand paper is rubbed on the surface, a thin layer of wood is removed resulting smooth surface. The grades of sandpaper are usually stated as a number that is inversely related to the particle size. A small number such as 20 or 40 indicates a coarse grit, while a large number such as 1500 indicates a fine grit.

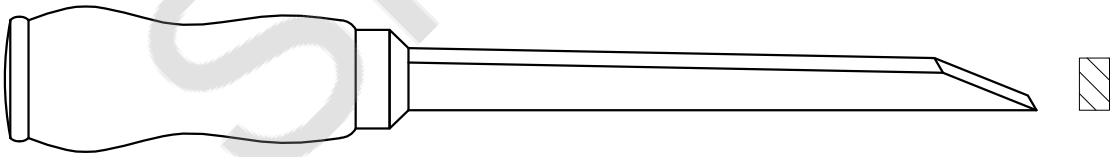


FIRMER CHISEL



BEVELED FIRMER CHISEL

PARING CHISEL



MORTISE CHISEL

d. Pincer

This is a tool similar to pliers and is used for pulling out nails, tacks etc.

e. Cabinet type screw driver

These are used for screwing and unscrewing screws in wood work. They are made in various sizes to suit different sizes of screws. The handle may be of hardwood or unbreakable plastic.

f. Ratchet screwdriver

These screwdrivers are used to insert the screw with one hand, leaving the other hand free to hold the object in position.

Carpentry Operations

Carpentry work involves a number of hand operations to finish the work to the desired shape and size with required accuracy. The following is the principal processes used in wood work:

- Marking
- Sawing
- Planing
- Chiselling
- Boring
- Grooving
- Rebating
- Moulding

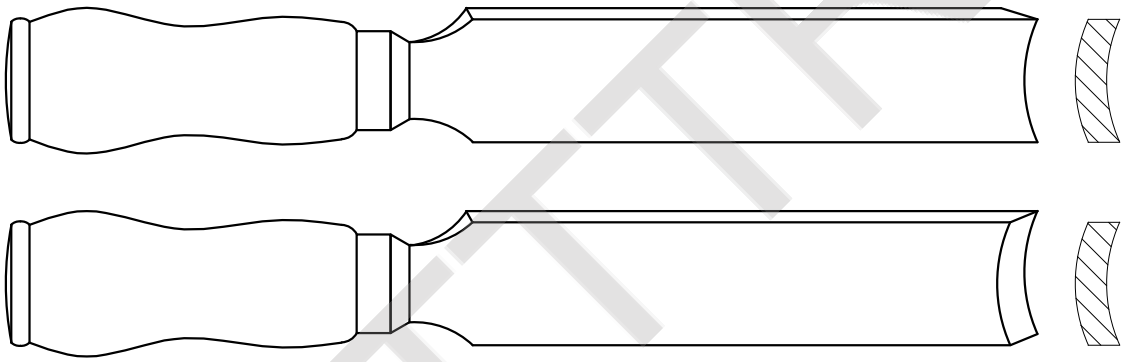
Wood working machines and power tools

Modern carpentry shop, in addition to the hand tools described earlier, requires the use of some power-driven machines, where large scale production is to be obtained. The machines commonly used are:

Wood working lathe **:** is employed primarily for turning jobs in making cylindrical parts.

Circular saw **:** used for ripping, cross cutting, mitering, bevelling, and grooving in large scale.

Band saw **:** is designed to cut wood by means of an endless metal saw band that travels over the rim of two or more rotating wheels.



GOUGE CHISELS

Wood planer : designed for planing large and heavy stock at a comparatively faster rate.

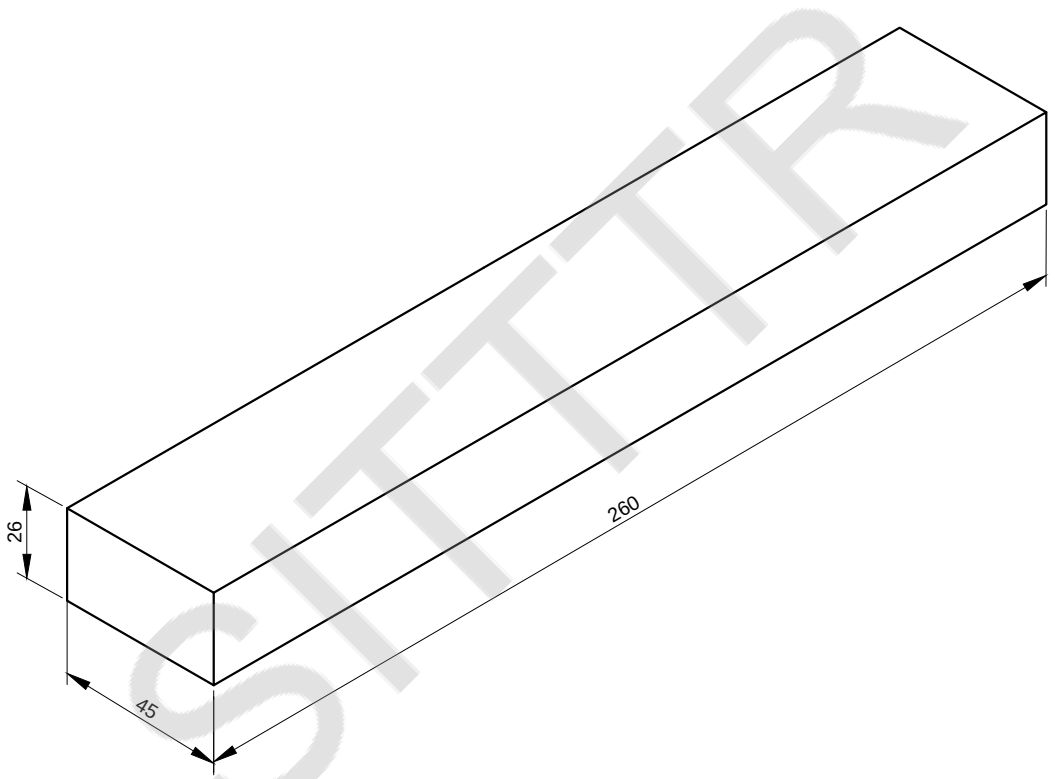
Mortiser : is used for cutting mortise (deep square slot) which are very laborious and time consuming operations.

Sanding machines : performs a sand preparing job (finishing wooden surface) to produce a uniformly sanded surface.

*****

Exercise No.1 Date:

PLANING PRACTICE



All dimensions are in mm

Exercise No.1 Date:

PLANING PRACTICE

Aim :

To practice planing operation in the given work piece as per drawing.

Materials required :

A wooden reaper of size 260 x 50 x 30mm.

Tools required :

Steel rule, Try square, Marking knife, Marking gauge, Mallet, Metal jack plane, Firmer chisel, Carpenter's vice etc.

Operations to be carried out :

Measuring, marking, planing, chiselling, checking and finishing.

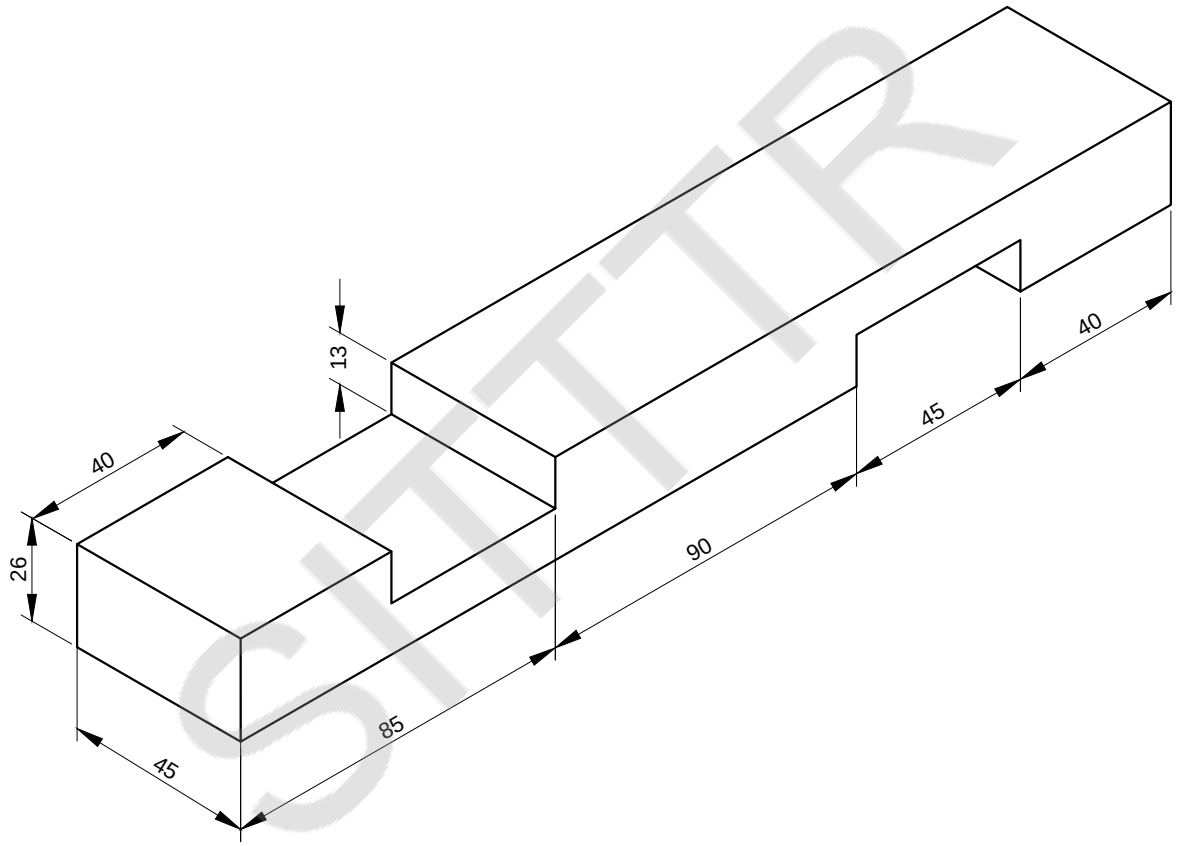
Procedure :

- Fix the given reaper horizontally on the vice and plane one of its broad surfaces with the help of metal jack plane.
- Plane the long adjacent side perpendicular to the previously planed surface.
- Taking the planed surface as base, mark the required width and thickness using marking gauge as shown in figure.
- Plane the marked faces to required size.
- Finally, cut the end faces with the help of firmer chisel and mallet.
- Check and finish the work.

Result :

Exercise No.2 Date:

CHISELING PRACTICE



All dimensions are in mm

Exercise No.2 Date:

CHISELING PRACTICE

Aim :

To practice sawing and chiselling operations in the given work piece as per drawing.

Materials required :

A wooden reaper of size 260x50x30mm.

Tools required :

Steel rule, Try square, Marking knife, Marking gauge, Mallet, Metal jack plane, Firmer chisel (40,25), Tenon saw, Carpenter's vice etc.

Operations to be carried out :

Measuring, marking, planing, sawing, chiselling, checking and finishing.

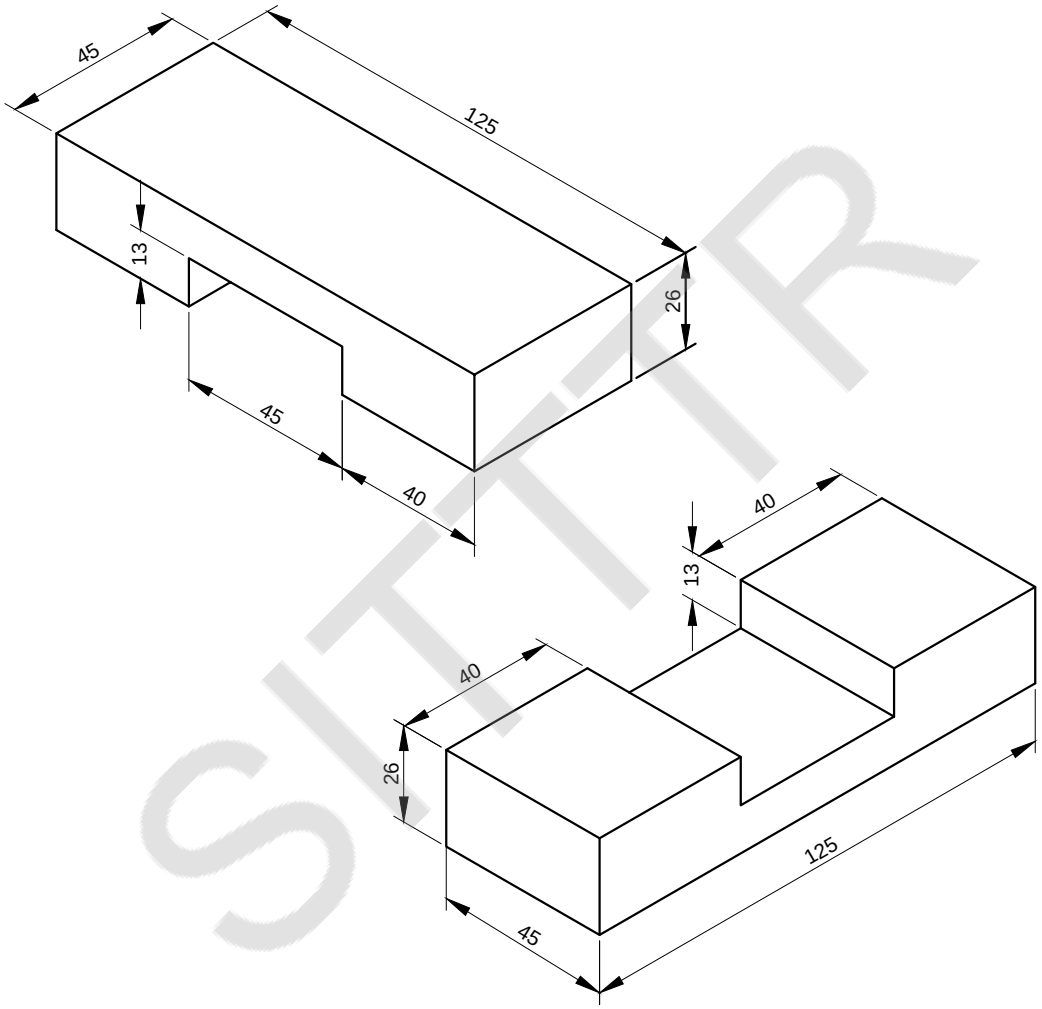
Procedure :

- Cut a wooden reaper of size 260x50x30mm from the given long reaper, using tenon saw.
- Fix it on a carpenter's vice and plane its four sides so as to get a rectangular cross section of size 45x26mm using a metal jack plane.
- Mark the dimensions on it by using a marking knife, marking gauge and try square.
- Cut the slots and remove excess material from the bar using tenon saw, firmer chisel and mallet.
- Check and finish the work.

Result :

Exercise No.3 Date:

CROSS-HALVED JOINT



All dimensions are in mm

Exercise No.3 Date:

CROSS-HALVED JOINT

Aim :

To make a Cross-halved joint as per drawing.

Materials required :

A wooden reaper of size 260x50x30mm.

Tools required :

Steel rule, Try square, Marking knife, Marking gauge, Mallet, Metal jack plane, Firmer chisel (40,25), Tenon saw, Carpenter's vice etc.

Operations to be carried out :

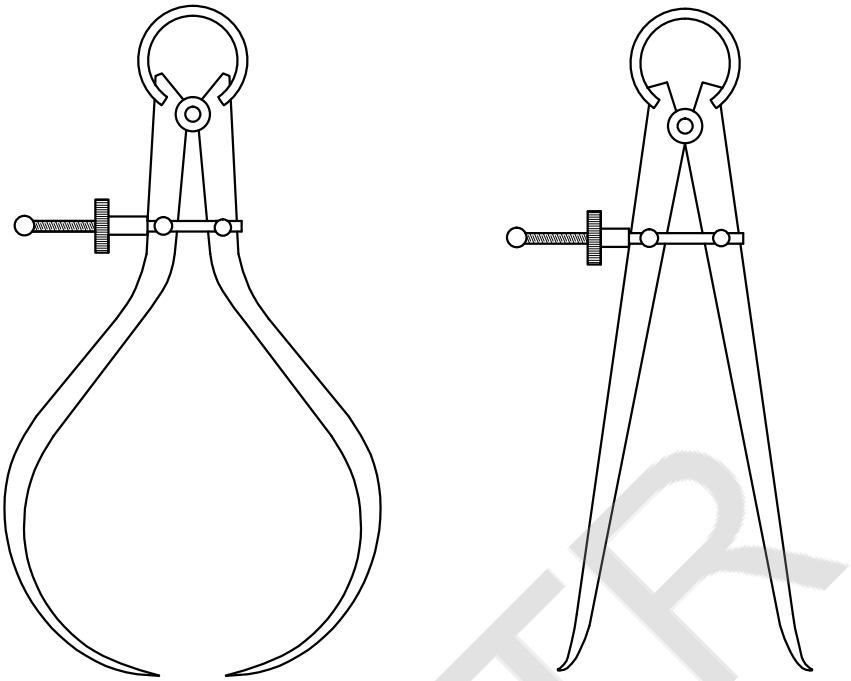
Measuring, marking, planing, cutting, sawing, chiselling, checking and finishing.

Procedure :

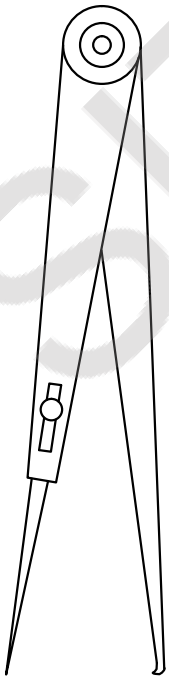
- Cut a wooden reaper of required size from the given long reaper, using tenon saw.
- Fix it on a carpenter's vice and plane its four sides so as to get a rectangular cross section of size 45x26mm using a metal jack plane.
- Mark the dimensions on it by using a marking knife, marking gauge, try square and cut it into two equal pieces.
- Cut recesses on both pieces as per drawing using firmer chisel and mallet to make a Cross-halved joint.
- Check and finish the work.

Result :

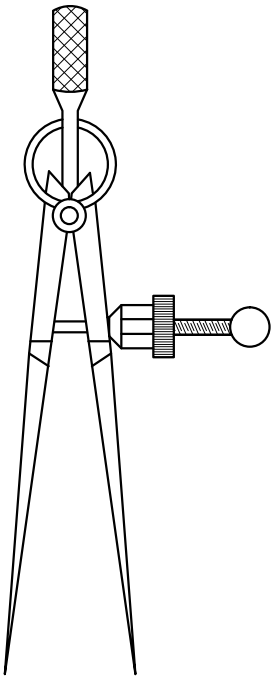
FITTING



SPRING OUTSIDE & INSIDE CALIPER



JENNY CALIPER



SPRING DIVIDER

FITTING

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO2	**Make use of various tools, machines, instruments and power tools used in the Fitting shop to make fitting joints**		
M2.01	i) Explain safety precautions ii) Demonstrate various tools, machines, instruments and power tools used in the Fitting shop.	3	Understanding
M2.02	Demonstrate various operations like Measuring, Marking, Cutting, and Filing.	3	Understanding
M2.03	Construct a simple fitting joint involving measuring, Marking, Cutting and Filing.	12	Applying

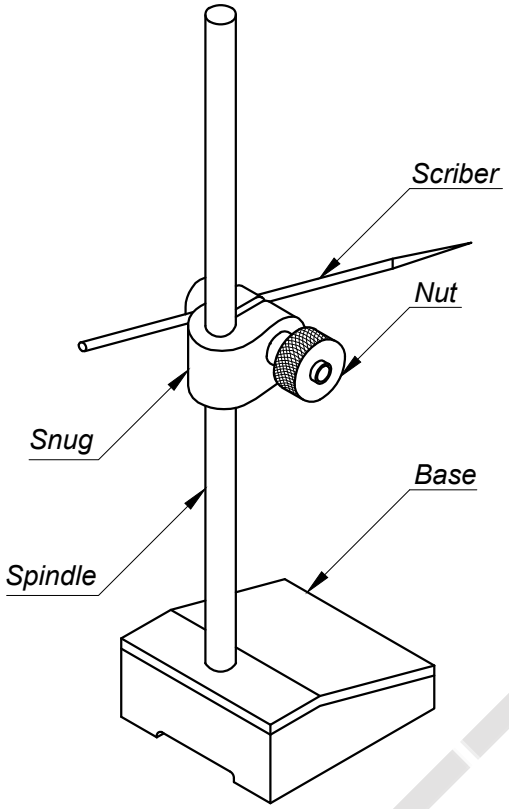
Introduction

These days small, medium and heavy industries are using automatic machines. But fitting work also plays a significant role for completing and finishing a job to the desired accuracy. Most of semi-finished works can be accomplished with fairly good degree of accuracy in a reasonable time through various kinds of quick machining operations. They still require some minor operations to be performed to finish the job by hand. The term 'Bench work' denotes the production of an article by hand on the bench. Whereas 'Fitting' is the assembling of parts together and removing metals to secure the necessary fit, by keeping accurate dimension and may or may not be carried out at the bench. These two types of work require the use of a large number of hand tools and other devices or equipment that involve a number of operations for accomplishing the work to the desired shape and size. Some of the commonly used tools are discussed as under.

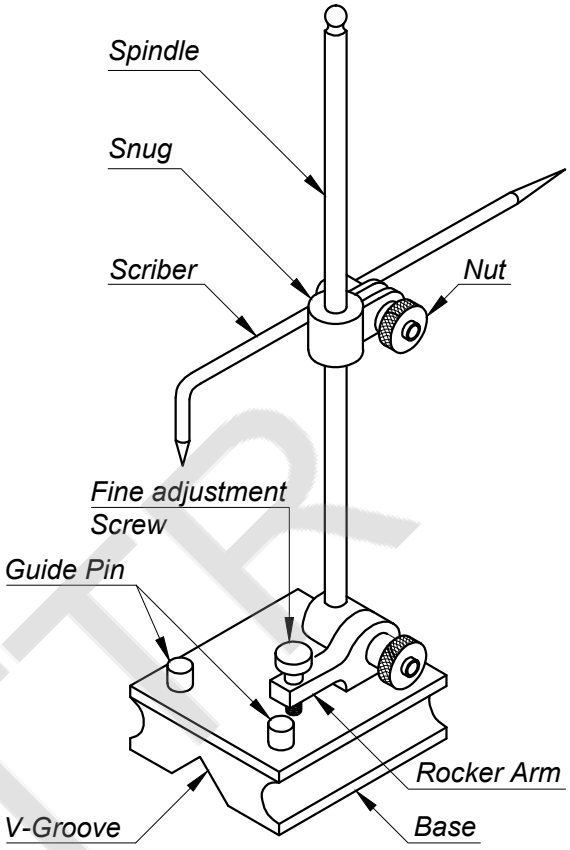
1. Measuring & Marking tools

a) Calipers

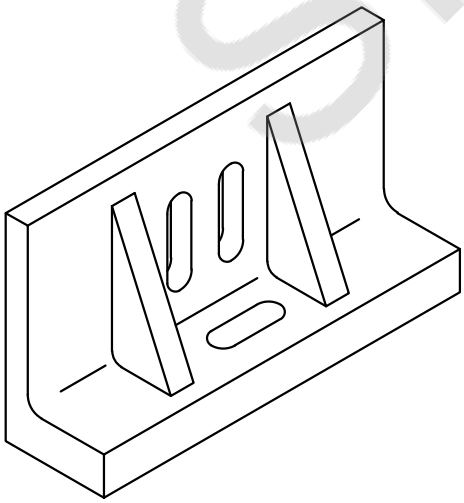
A caliper is used to transfer and compare a dimension from one object to another or from a part to scale or micrometer where the measurement cannot be made directly. The commonly used calipers are shown in the figure.



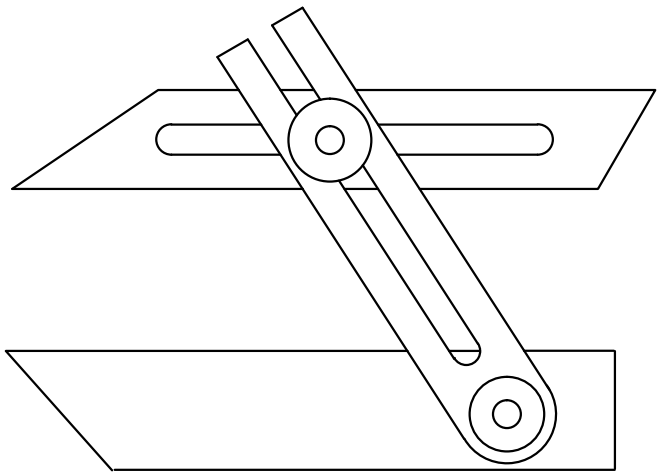
ORDINARY
SURFACE GAUGE



UNIVERSAL
SURFACE GAUGE



ANGLE PLATE



BEVEL SQUARE

b) Dividers

Dividers are very useful instruments employed in marking work. They are similar in construction to the calipers but their legs are not bent. Also, the free ends of the two legs are sharp points. They may have either a friction-joint or a spring arrangement, as shown in figure. Their principal use is in measuring distance between two points or parallel lines on a flat surface, dividing a given length in a definite ratio, drawing circles and arcs and transferring dimensions from scales to objects.

c) Outside caliper

An outside caliper is a two legged steel instrument with its legs bent inwards as shown in figure. It is used for measuring or comparing thickness, diameters, and other outside dimensions. A steel rule must be used in conjunction with them if a direct reading is desired. The side of caliper is specified by the greatest distance it can be opened at the tips of the legs.

d) Inside caliper

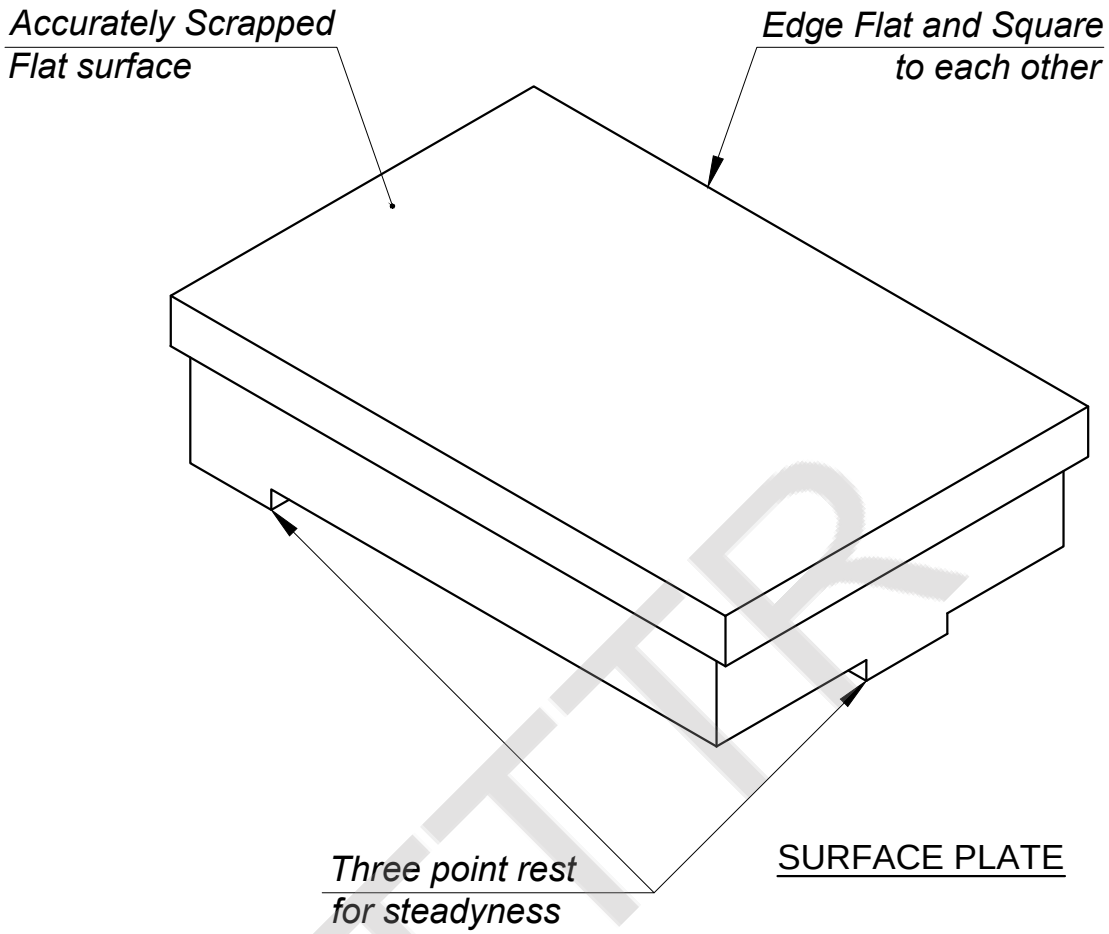
An inside caliper is exactly similar to an outside caliper in appearance with its leg bent outward as shown in figure. This is used for comparing or measuring hole diameters, distances between shoulders, or other parallel surfaces of any inside dimensions. To obtain a specific reading steel scale must be used, as with the outside calipers.

e) Spring caliper

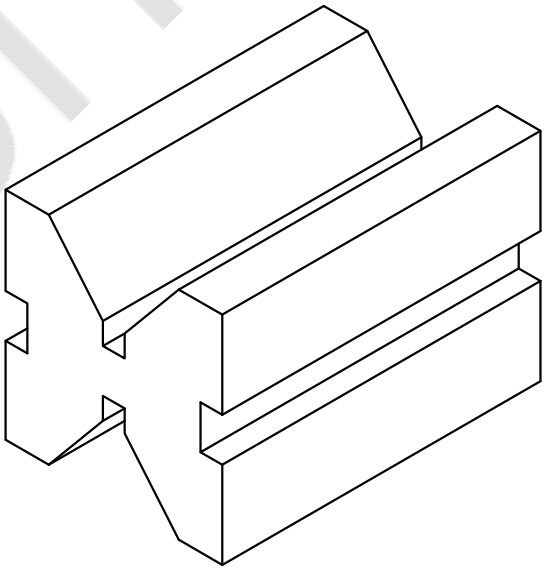
For finer work the use of spring calipers both outside and inside advocated. A loop spring on the top of the joint between two legs applies force tending to separate the legs at the bottom. An adjusting screw and nut keep the legs in position. An inside spring caliper has legs turned outward to make contact with the inside of holes and grooves. A steel rule must be used in conjunction with them, as with ordinary calipers. When a spring caliper is applied to an object, it must make sure contact but not be forced. A sense of "fell" or "touch" is necessary to use a caliper successfully.

f) Hermaphrodite or jenny caliper

This is sometimes called odd – leg caliper. It has one pointed leg like a divider and one bent leg as shown in figure. The caliper is extremely useful for scribing lines parallel to the edge of the work and for finding the center of a cylindrical work. A steel rule is a necessary adjunct.



SURFACE PLATE



V-BLOCK

g) Ordinary scribing block or surface gauge

Figure illustrate the surface gauge which is a principal marking tool used generally in the fitting and the machine shops. It is made in various forms and sizes. It consists of a cast iron sliding base fitted with a vertical steel rod. The scriber or marker is positioned or set into an adjustable device using a knurled nut at one end. The scriber can be loosened or tightened by means of the nut. The marker is used to set it at any desired inclination, moved to and fro inside the hole accommodating it or adjust its height along the vertical pillar. It is commonly used in conjunction with either a surface plate or marking table. It is used for locating centers of round rod held in V-block, describing straight lines on work held firmly in its position by means of a suitable device like angle plate and also in drawing a number of lines parallel to a true surface.

h) Universal scribing block or universal surface gauge

It is a more accurate and more improve variety of simple surface gauge with some additional features. This can be tilted or clamp at any height on the spindle and at any convenient angle by engaging the clamping nut. Very minute adjustment in height can be made by the fine adjustment screw at the base.

i) Angle plate

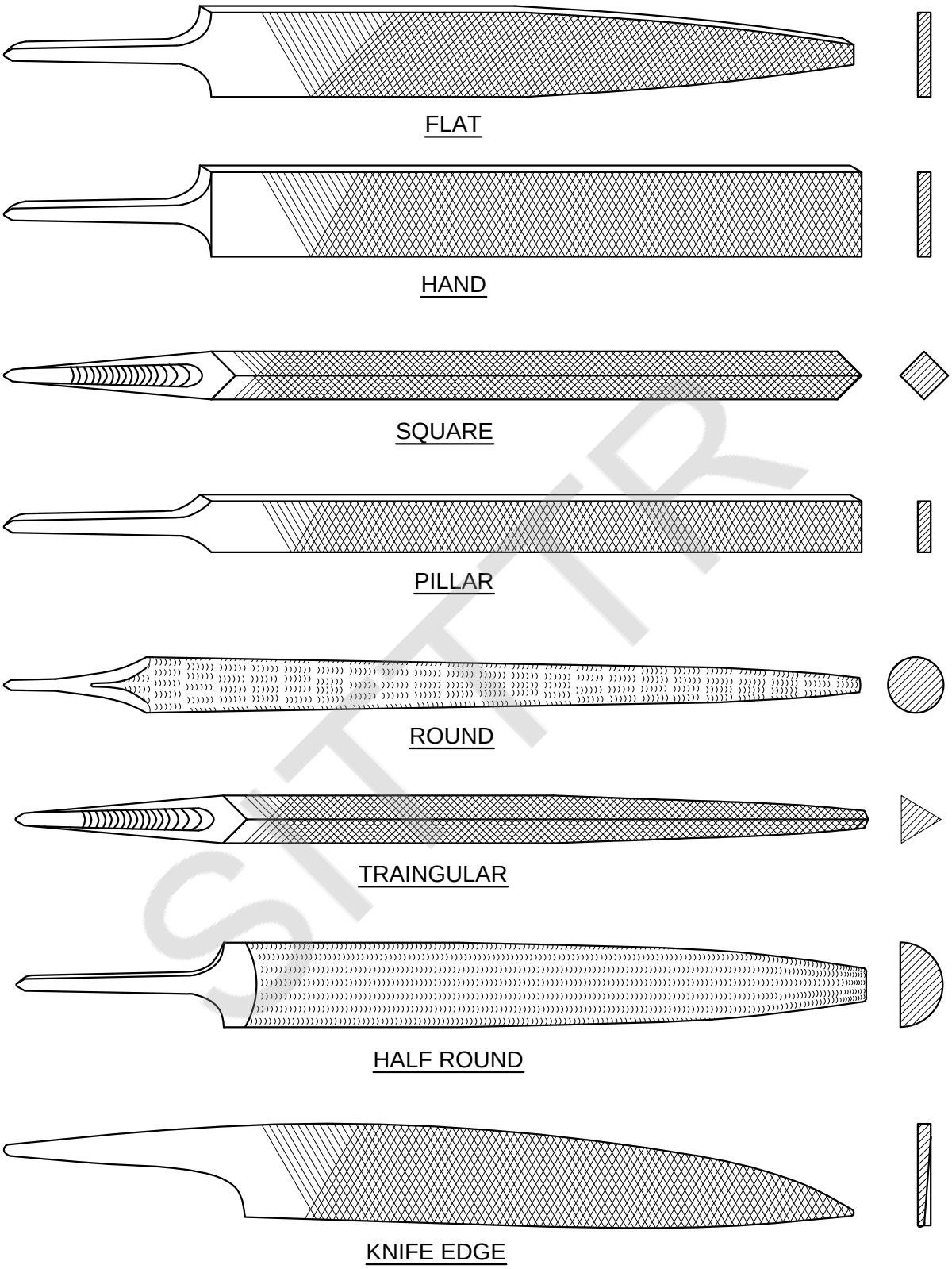
The angle plate which is made of grey cast iron has two plane surfaces at right angles to each other. This is used in conjunction with the surface plate for supporting work in the perpendicular position. It has various slots in it to enable the work to be held firmly by bolts and clamps.

j) Bevel square

An instrument known as bevel gauge is widely used for checking, comparing or transferring angles and laying out work. This tool is illustrated in figure. It consists of two adjustable blades which may be moved into almost any position to give any desired angle. But no direct reading is obtained, and the angle must be set or checked from some other angular measuring device.

k) Surface plate

The surface plate as shown in figure is used for testing the flatness of work itself and is also used for marking - out work. This is used for small pieces of work while the marking – out table is used for larger jobs. Surface plates are made of grey cast iron and of solid design or with ribs. They should be well and reflection-free illuminated and rest horizontally on firm support, the working height being about 800 mm from the floor. The marking-out surface must be protected from rust and dirt and wiped clean and smeared with grease or oil after use.



TYPES OF FILES

l) Vernier caliper

Vernier caliper is a precision measuring instrument which is used for outside, inside and depth measurements. Its accuracy is 0.02mm. The vernier scale for 0.02mm least count has the scale length of 49mm and it is divided to 50 equal divisions. Hence one division of Vernier scale is 1/50mm less than 1mm. This gives a least count of 0.02mm.

m) Vernier height gauge

A Vernier height gauge consists of a heavy base, a graduated beam, a sliding head with Vernier sliding jaws holding the scriber and a fine adjustment clamp. It is similar to large Vernier calipers in construction, except that it consists of a heavy base which allows the gauge to stand upright instead of a fixed jaw in a Vernier. The movable jaw of Vernier height gauge consists of a projection or extension which is levelled to sharp edge for scribing lines at any required height.

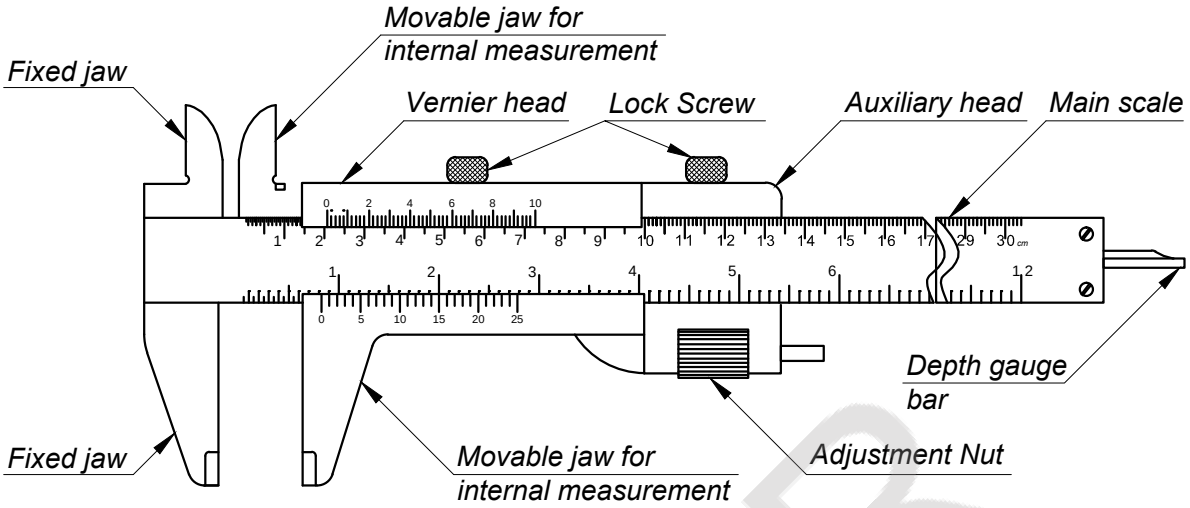
n) V – Block

The V-block is a block of steel with v-shaped grooves. Round shaped work pieces which are to be marked or drilled are placed on v – supports. In this way they are firmly supported in a horizontal position and cannot rotate easily. V-Blocks of the following sizes are found to be most useful: length from 50 to 250 mm width and height from 50 to 100 mm. For long cylindrical work, several blocks of the same size are used as set.

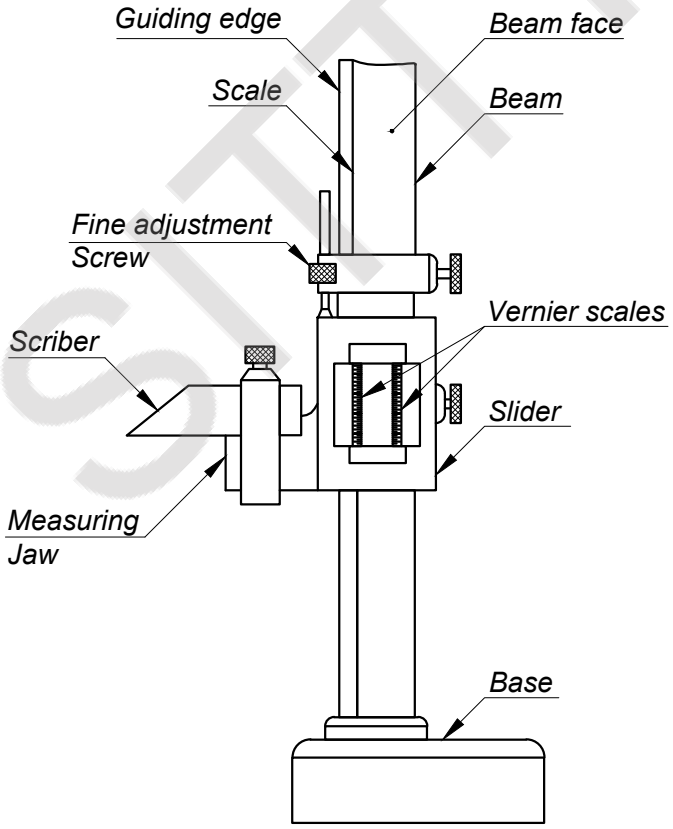
o) Straight edge

Straight edges are commonly used for testing the straightness and flatness of plane surfaces. The ordinary shape is rectangular but for accurate work one edge is bevelled or formed into a thin knife edge as shown in figure the narrow edge is the working surface, while the wide edge adds to the rigidity of the tool and serves as its base when not in use. Placing the straight-edge on its edge protects the working surface from damage and from getting dirty.

Flatness is checked by a light test. The narrow edge of the tool is applied to the surface to be tested and kept horizontally at eye level watching for light between the straightedge and the surface along the straightedge. Light seen at one place or another indicates deviation from straightness. This method proves very accurate and within 3 to 5 microns.



VERNIER CALIPER



VERNIER HEIGHT GAUGE

2. Cutting tools

a. Files

It is used for removing excess material to smoothen or fit metal parts. They are generally forged out of high carbon steel or tungsten steel, followed by cutting of teeth, hardening and tempering etc.

Classification of files

i. Cut of files

The files are divided into two groups as per cut of the teeth, ie. Single cut and Double cut. On single cut files, the teeth are cut parallel to each other running across the faces and at an angle of 60 to the center line of the file. These types of files are frequently termed as flats and are used for very hard metals. In double cut files, there are two sets of teeth. The first set is similar to those of single cut files. The second set of teeth is cut diagonally across the first set of teeth at an angle of 80 to the center line of the file. It is used for general work.

ii. Shape of files

The shape of file is its general outline and cross-section. Files are made in hundreds of shapes. Figure show the most commonly used shapes.

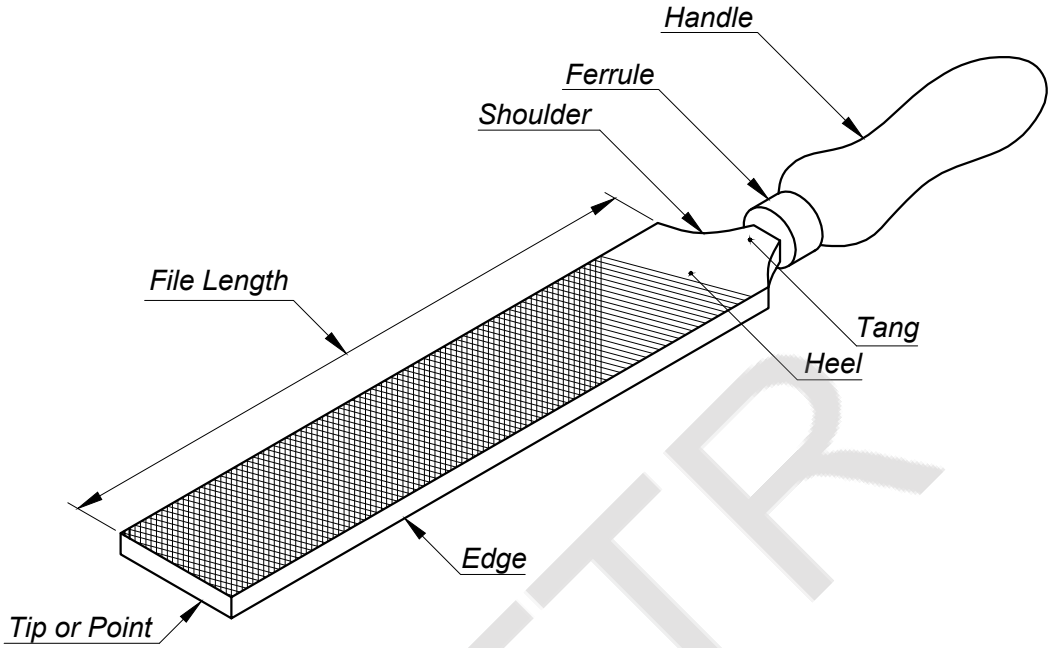
a. ***Flat file*** **:** This is tapered in width and thickness, and one of the most commonly used files for general work. They are always double – cut on the faces and single – cut on the edges.

b. ***Hand file*** **:** This is parallel in width, and tapered in thickness. A hand file is used for finishing flat surfaces. It has one edge (i.e., it is uncut) and therefore, is useful where the flat file cannot be used. They are always double – cut.

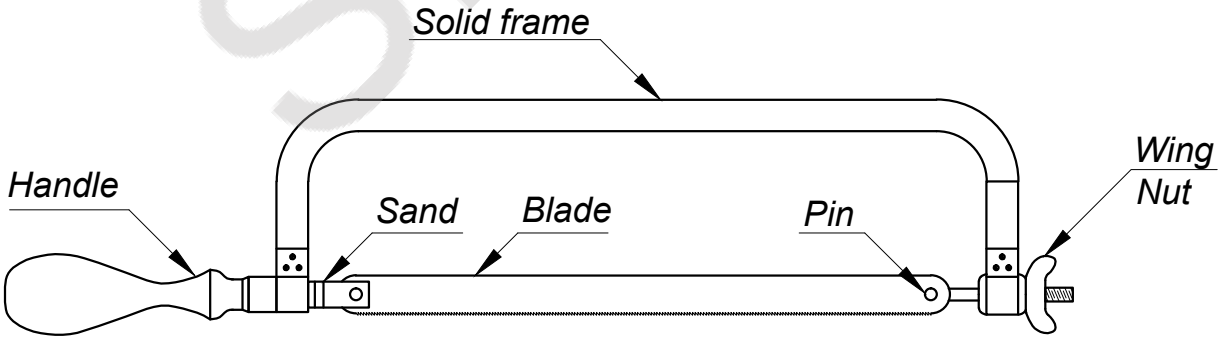
c. ***Square file*** **:** This is square in cross section, double – cut, and tapered towards the point. This is used for filing square corners, enlarging square or rectangular openings as splines and keyways.

d. ***Pillar file*** **:** Pillar files are double – cut, narrow and of rectangular section. It has one safe edge, and is used for narrow work, such as keyways, slots and grooves.

e. ***Round files*** **:** They are round in cross – section and usually tapered, when they are termed rat – tailed. When parallel they are described as parallel round. Round files are used for filing curved surfaces and enlarging round holes and forming fillets. They may be single – cut or double – cut.



PARTS OF A FILE



HACK SAW

f. ***Triangular files:*** The square or triangular file is tapered, double – cut, and the shape is that of an equilateral triangle. They are used for rectangular cuts and filing corners less than 90.

g. ***Half round file*** : This is tapered double – cut and its cross section is not a half circle but only about one-third of a circle. This file is used for round cuts and filing curved surfaces.

h. ***Knife edge file*** ***:*** This is shaped like a knife, tapered in width and thickness and double – cut. They are used filing narrow slots, notches, and grooves.

iii. Special type files

There are number of file in less common use. They are all used for special purposes and not in general use. They are wording file, needle file, riffler etc. A wording file is a thin flat file having fine cut teeth, about 100 mm long. This is widely employed for all kinds of fine work. A needle file is made in sizes from 100 to 200 mm, of various shapes and cuts. They are extremely delicate and are used for fine work. Rifflers are curved upwards at the ends into an arc. They are used to reach the bottom of a sinking and for filing the insides of castings.

b. Hacksaw

It is used to cut metals of different sections. It is also used to cut slots and contours. It consists a frame, blade and handle. There are two types of hacksaw frames.

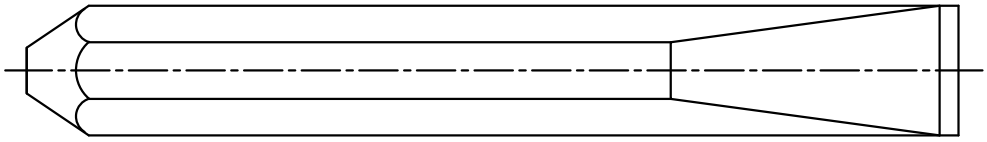
(a) Solid frame

(b) Adjustable frame

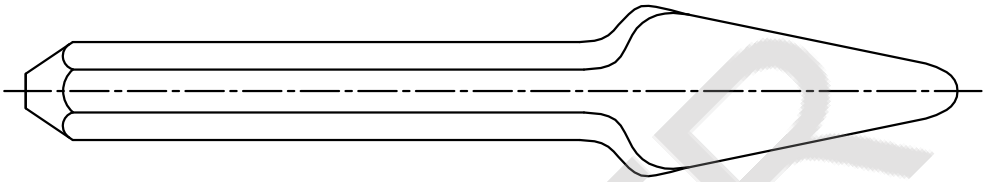
The blade is fixed with its teeth facing forward so that it cuts material in the forward stroke. The frame is made of mild steel whereas the blade is made of high carbon steel.

c. Chisels

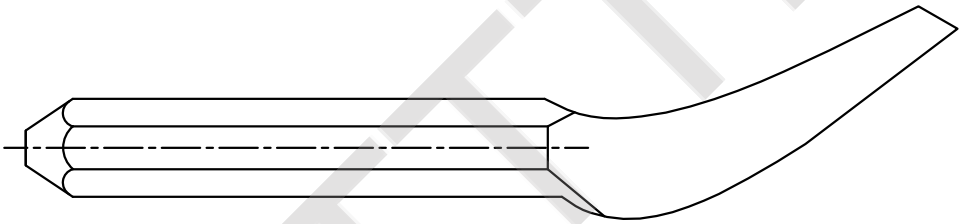
Chisels are used for cutting and chipping away pieces of metal and are made of carbon steel usually rectangular, hexagonal or octagonal cross section. They are forged to shape, roughly ground, and then hardened and tempered. Afterward the edge is ground sharp to the correct cutting angle, care being taken not to overheat the steel and draw the temper. The cutting angle given to the chisel is determined mainly by the nature of the metal to chip. It varies between 35 and 70°, the less acute angles being for the harder and tougher metals.



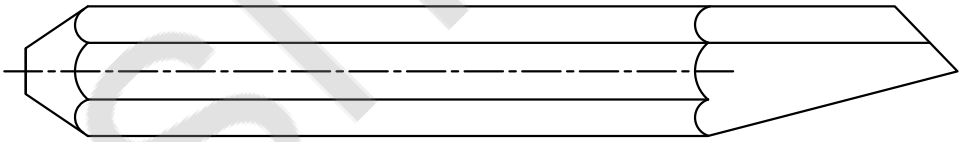
FLAT CHISEL



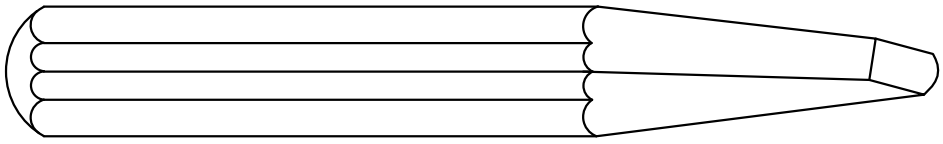
CROSS CUT CHISEL



HALF ROUND CHISEL



DIAMOND POINT CHISEL



ROUND NOSE CHISEL

i. Flat chisel

The flat chisel as shown in figure is the most common of all the chisels used in engineering. It is the chisel which is used for most of the general chipping operations. It may be used for removing surplus metal from surfaces of the jobs.

ii. Crosscut chisel

The cross-cut chisel figure or cape chisel as it is sometimes called, is used for cutting grooves in large surfaces previous to using the flat chisel, and is also used in cutting key ways in wheels and shafts. The cutting edge is slightly wider than the supporting metal to provide clearance.

iii. Half round chisel

A half – round chisel is shown in figure and of particularly useful for cutting oil-ways or grooves in bearing, bosses and pulleys, etc. they are also used for setting-over pilot holes. When a hole is to be drilled a smaller or pilot hole is drilled first. The shank is reduced to a half-round taper, which is bevelled at the end to give a circular edge.

iv. Diamond point chisel

The diamond-point chisel as shown in figure is used for cutting vee grooves, cleaning corners and squaring small holes. The chisel is drawn to a square section. The end is ground off at an angle producing the diamond shape.

v. Side chisel

A side chisel is shown in figure. This is particularly useful in chipping and removing the surplus metal in cotter ways and slots, which may have to be cut by hand after having been drilled. The shank of this chisel is bent out a little sideway and then vertically down again.

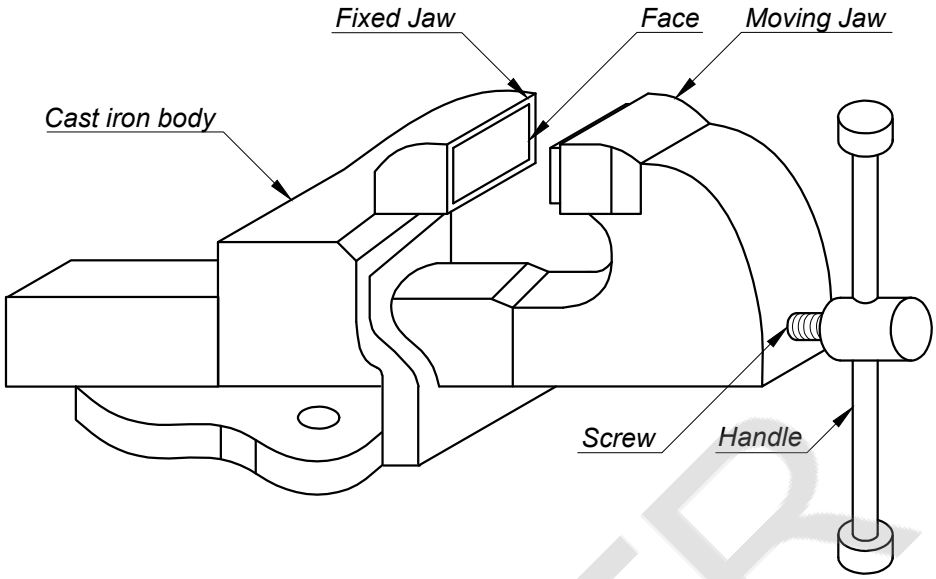
3. Striking tools

a. Ball peen hammer

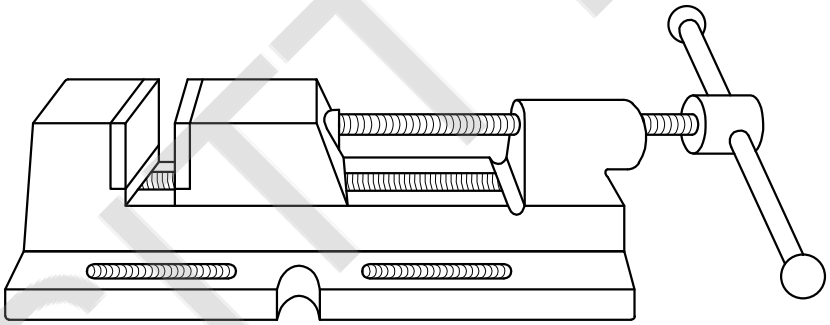
It is a striking tool suitable for forming rivet head and weighs from 0.5 to 1.5 kg. It is used for striking punches while marking.

b. Straight peen hammer

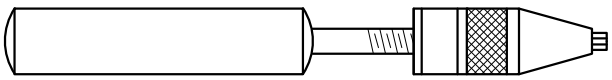
It is used to spread metal at right angle to the line of striking and for using in corners and slot & weighs from 0.5 to 1.5 kg.



BENCH VICE



TOOL MAKERS VICE



PIN VICE

c. Cross peen hammer

It is used to spread metal in the line of striking and weigh from 0.5 to .5 kg. it is also used for striking small work piece.

d. Sledge hammer

It is a striking tool which is comparatively larger in size and heavier in weight and weight of it range from 3 to 8 kg. It is used for striking flat surface.

4. Holding devices

a. Bench vice

It is made of cast iron or cast steel and it is used to hold work for filing sawing, threading and other hand operation. It consists of a fixed jaws and movable jaws. The size of the vice is specified by the width of the jaws and maximum opening between the jaws.

b. Leg vice

It is used by black smith but it is also suitable for heavy hammering, chipping and cutting in fitters work.

c. Hand vice

It is used for holding screws, rivets, keys and other similar object which are too small to be conveniently held in the bench vice. The vice is held in one hand and the required operation is performed by other hand.

d. Pin vice

It is used for holding small diameter works, such as wire and pins. The work is gripped between the jaws of the chuck by rotating the handle.

e. Tool makers vice

It is particularly useful for holding small work which require filing or drilling and for such work as laying out small jobs on the surface plate. It is made of mild steel.

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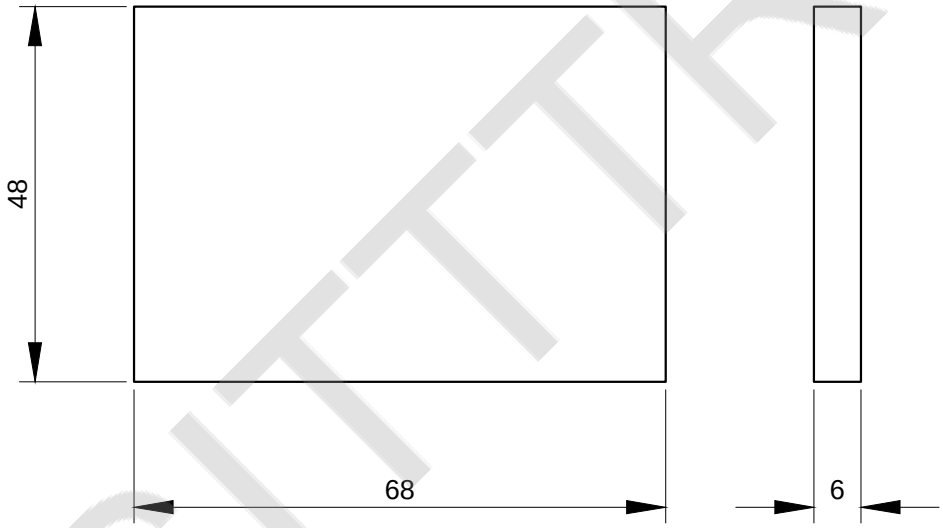
Exercise No: 1 Date:

FILING PRACTICE



All dimensions are in mm

Exercise No: 1 Date:

FILING PRACTICE

Aim :

To practice filing and make the shape as per given figure.

Materials required :

MS flat plate of size 70 x 50 x 6 mm.

Tools required :

Flat file, hacksaw frame with blade, try square, steel rule, & scriber.

Operations to be carried out :

Measuring, marking, cutting, filing & finishing.

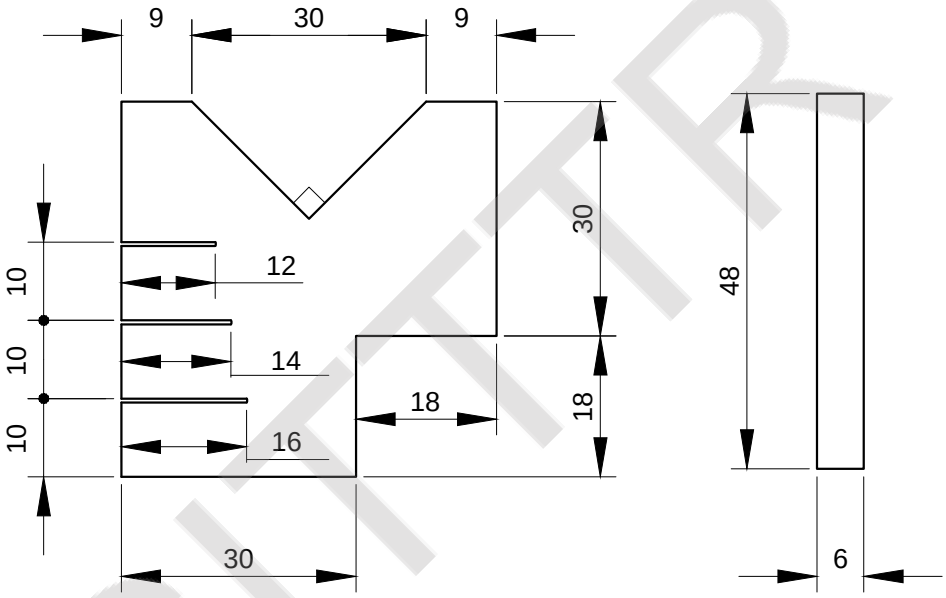
Procedure :

- Make sure the required length of flat plate using a steel rule and scriber.
- Cut the work piece with hacksaw blade with frame.
- Hold the work piece in the bench vice and file its one edge to get a flat edge.
- Check its flatness using a steel rule and try square.
- File adjacent side and check the angle (90°) with a try square.
- File the other two edges of the work piece to get the dimension as per figure
- Check the work for inspection

Result :

Exercise No: 2 Date:

HACKSAW CUTTING PRACTICE



All dimensions are in mm

Exercise No: 2 Date:

HACKSAW CUTTING PRACTICE

Aim :

To make a hacksaw cutting practice.

Materials required :

MS flat plate of size 50 x 50 x 6 mm.

Tools required :

Flat file, hacksaw frame with blade, try square, steel rule, scriber, surface plate, V-block, vernier height gauge, ball peen hammer, center punch, triangular file, & smooth file.

Operations to be carried out :

Measuring, chalk applying, marking, cutting, filing & finishing.

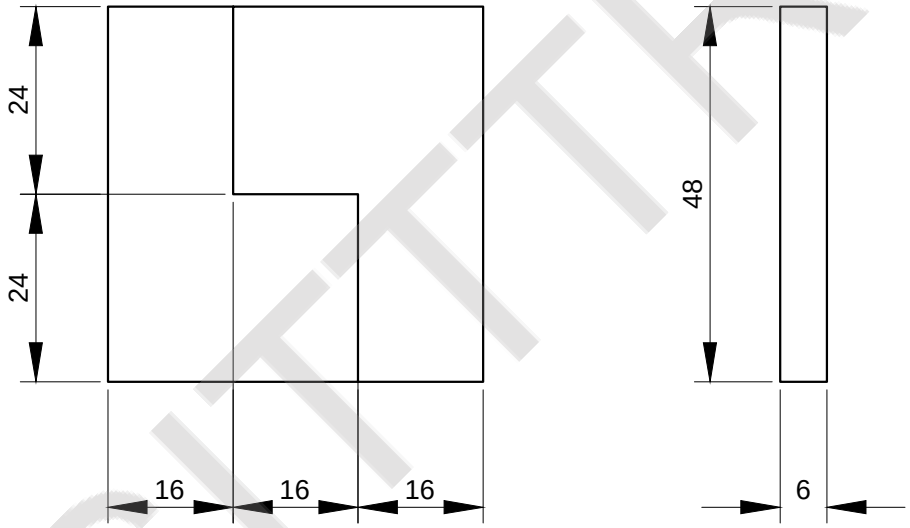
Procedure :

- Cut the MS flat of size 50 x 50 x 6 mm using hacksaw frame with blade.
- File and finish the two adjacent sides up to 90º.
- Apply chalk on the one side of the work piece.
- Mark the dimensions as per the drawing using surface plate, V-block & vernier height gauge.
- Punch the witness mark through the required lines.
- Cu the work piece in to V-shape and square shape and straight line cutting.
- File and finish the work for inspection.

Result :

Exercise No: 3 Date:

L - JOINT



All dimensions are in mm

Exercise No: 3 Date:

L - JOINT

Aim :

To make a L – joint.

Materials required :

MS flat plate of size 65 x 50 x 6 mm.

Tools required :

Flat file, hacksaw frame with blade, try square, steel rule, scriber, surface plate, V-block, vernier height gauge, ball peen hammer, center punch, triangular file, & smooth file.

Operations to be carried out :

Measuring, chalk applying, marking, cutting, filing & finishing.

Procedure:

1. Cut the MS flat of size 65 x 50 x 6 mm using hacksaw frame with blade.
2. File and finish the two adjacent sides up to 90º.
3. Apply chalk on the one side of the work piece.
4. Mark the dimensions as per the drawing using surface plate, V-block & vernier height gauge.
5. Punch the witness mark through the required lines.
6. Separate metal into two pieces by hack sawing.
7. File and finish the work using flat file and triangular file.
8. File and finish the all edges, surface & check the dimensions.
9. Remove the burrs and apply thin coat of lubricating oil.

Result :

WELDING

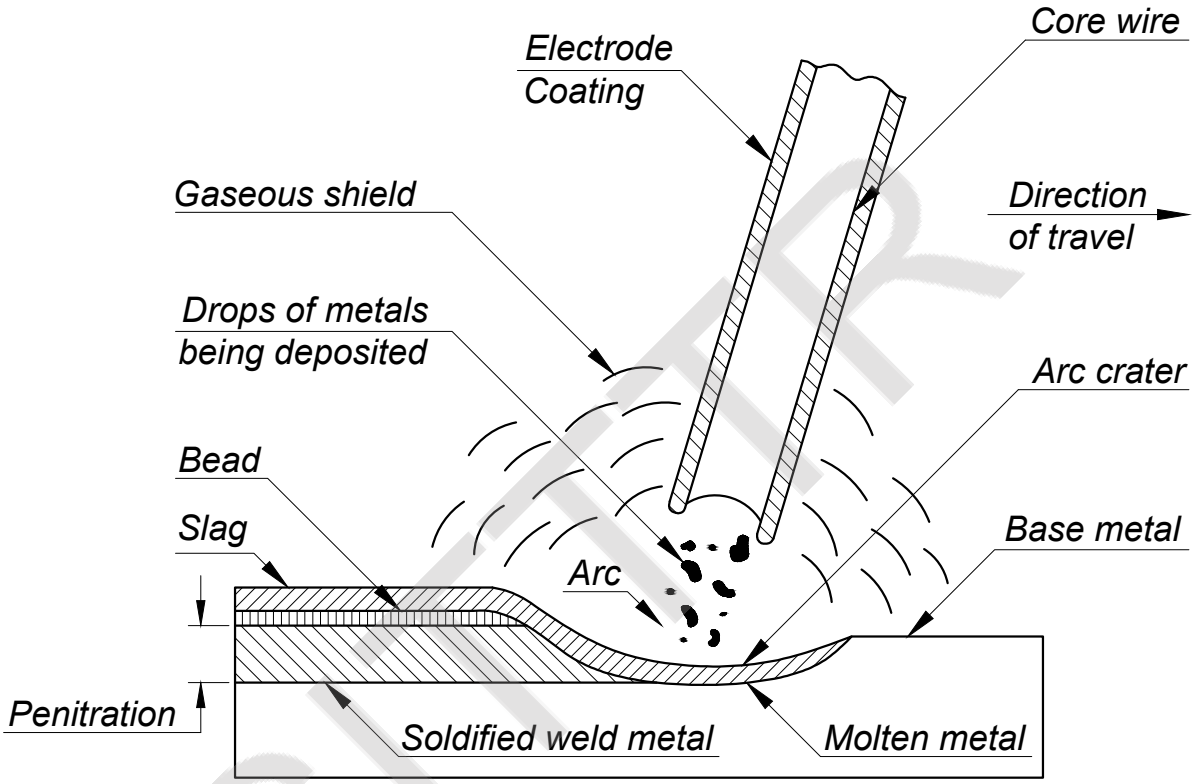
WELDING

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO3	**Make use of various tools, machines, instruments and power tools used in the Welding shop to make welding joint.**		
M3.01	i) Explain safety precautions ii) Demonstrate various tools/equipment and protecting devices used in welding shop.	3	Understanding
M3.02	Demonstrate an Arc welding machine, electrodes, earthing cable, poles etc. and practice on welding machine	3	Understanding
M3.03	Construct Straight line welding and Butt joint Welding.	12	Applying

Welding safety precautions:

To prevent injury to personnel, extreme caution should be exercised when using any types of welding equipment. Injury can twill from fire, explosions, electric shock, or harmful agents. Both the general and specific safety precautions listed below must be strictly observed by workers, who weld or cut metals,

- Do not permit unauthorized persons to use welding or cutting, equipment;
- Do not weld in a building with wooden floors, unless the floor', are protected from hot metal by means of fire, resistant fabric, and, or other fireproof material. Be sure that hot sparks or hot metal will not fall on the operator or on any welding equipment components.
- Remove all flammable material, such as cotton, oil, gasoline, etc from the vicinity of welding.
- Before welding or cutting, warn those in close proximity who are not protected to wear proper clothing or goggles.
- Remove any assembled parts from the component being welded that may become warped or otherwise damaged by the welding process.



ARC WELDING OPERATION

- Do not leave hot rejected electrode stubs, steel scrap, or tools on the floor or around the welding equipment. Accidents and/or fires may occur.
- Keep a suitable fire extinguisher nearby at all times. Ensure the fire extinguisher is in operable condition.

Introduction:

Welding is a process of joining similar metals by application of heat with or without application of pressure and with or without the use of filler metal.

Types of Welding

Welding may be classified under two broad headings

1. Plastic welding or pressure welding
2. Fusion welding or non pressure welding

In the plastic welding or pressure welding the piece of metal to be joined are heated to a plastic state and then forced together by external pressure. This procedure is used in forge welding, resistance welding, in which pressure is required.

In fusion welding or non pressure welding, the material at the joint is heated to a molten state and allowed to solidify. This includes gas welding, arc welding, thermit welding etc..

Welding Processes

1. **ARC Welding**

   a). Carbon Arc b). Atomic Hydrogen Arc c). Metal Arc

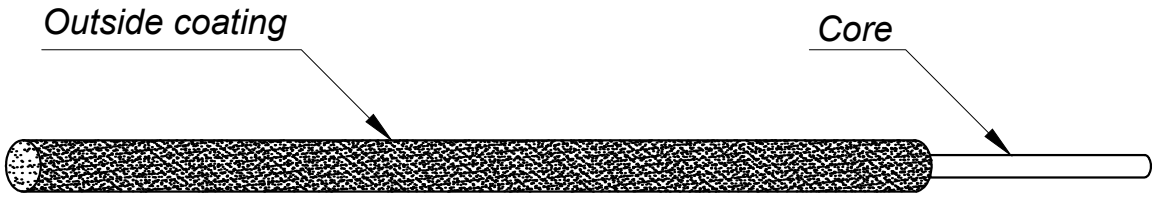
   d). Plasma Arc e). Gas Metal Arc (MIG) f). Submerged Arc

   g). Gas Tungsten Arc (TIG) h). Electro Slag

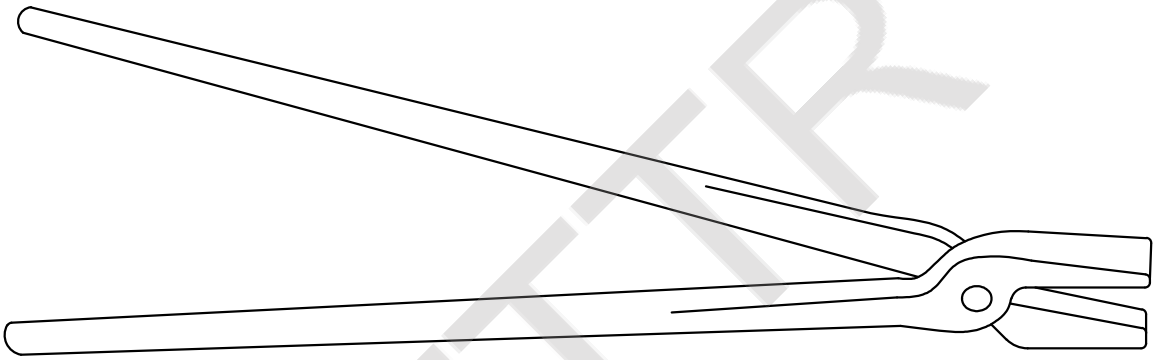
2. **GAS Welding**

   a). Oxy Acetylene gas welding b). Air Acetylene gas welding

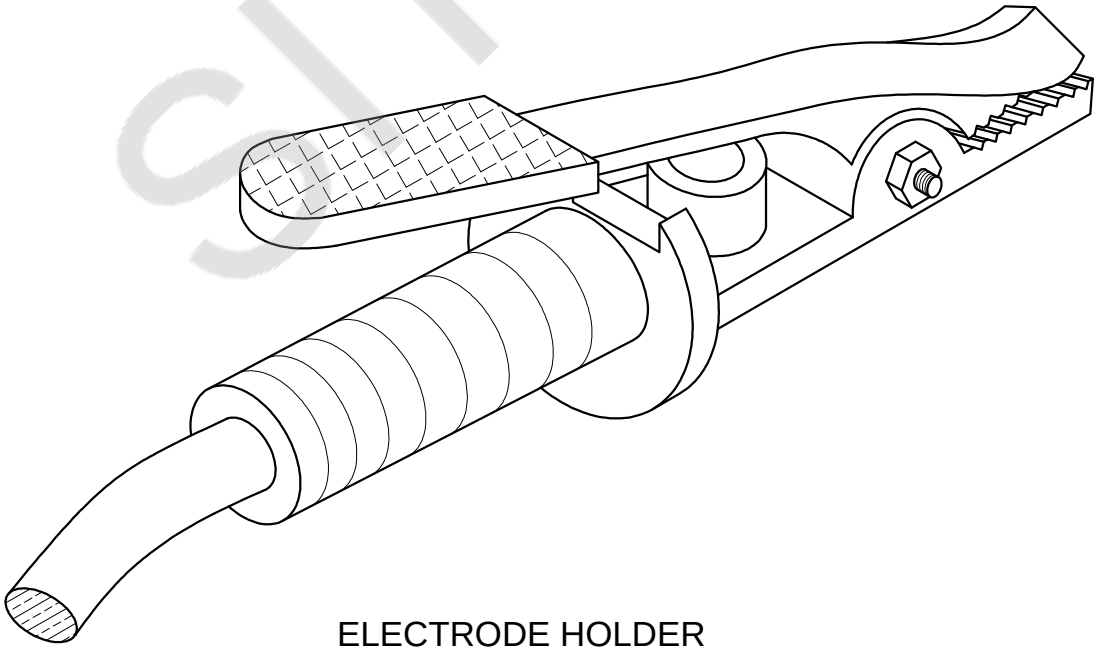
   c). Oxy Hydrogen gas welding



ELECTRODE



FLAT TONGS



ELECTRODE HOLDER

3. Resistance Welding

a). Butt b). Spot c). Seam

d). Projection d). Percussion

4. Thermit Welding

5. Solid State Welding

a), Friction b).Ultrasonic c). Diffusion d). Explosive

6. Modern Welding

a). Electron Beam b). Laser Beam

The arc welding is a fusion welding process in which the welding heat is obtained from an electric arc between the work and an electrode. The electric arc is produced when two conductors of an electric circuit are touched together and then separated by a small distance. The temperature of heat produced by the electric arc is of the order of 6000º C to 7000º C.

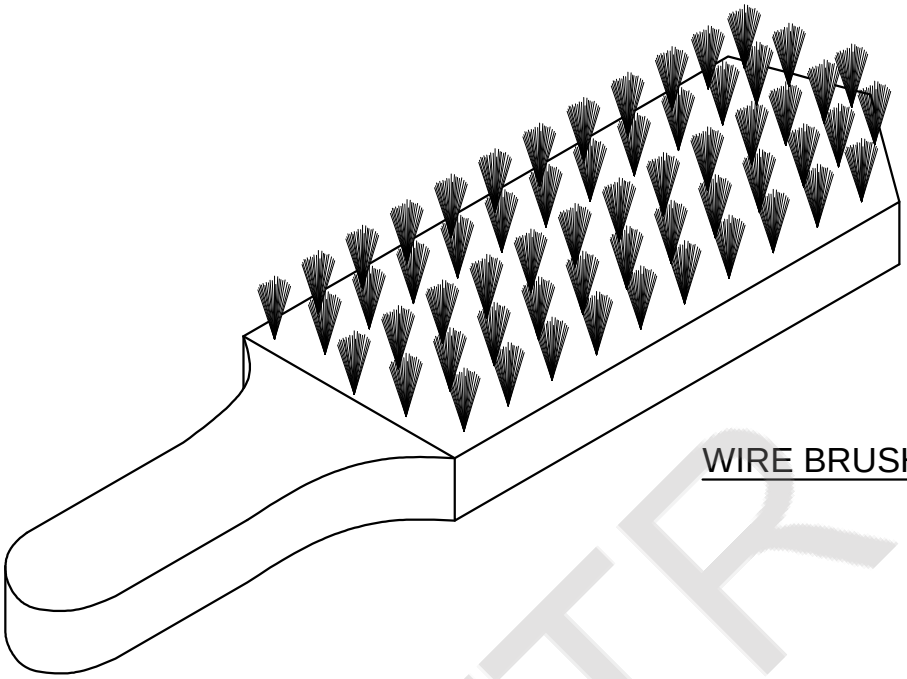
The most common method of arc welding is with the use of a metal electrode which supplies filler metal. The welding is done by first making contact of the electrode to a proper distance to produce an arc.

The direct current (DC) or alternate current (AC) may be used for arc welding, but the direct current is preferred for most purposes.

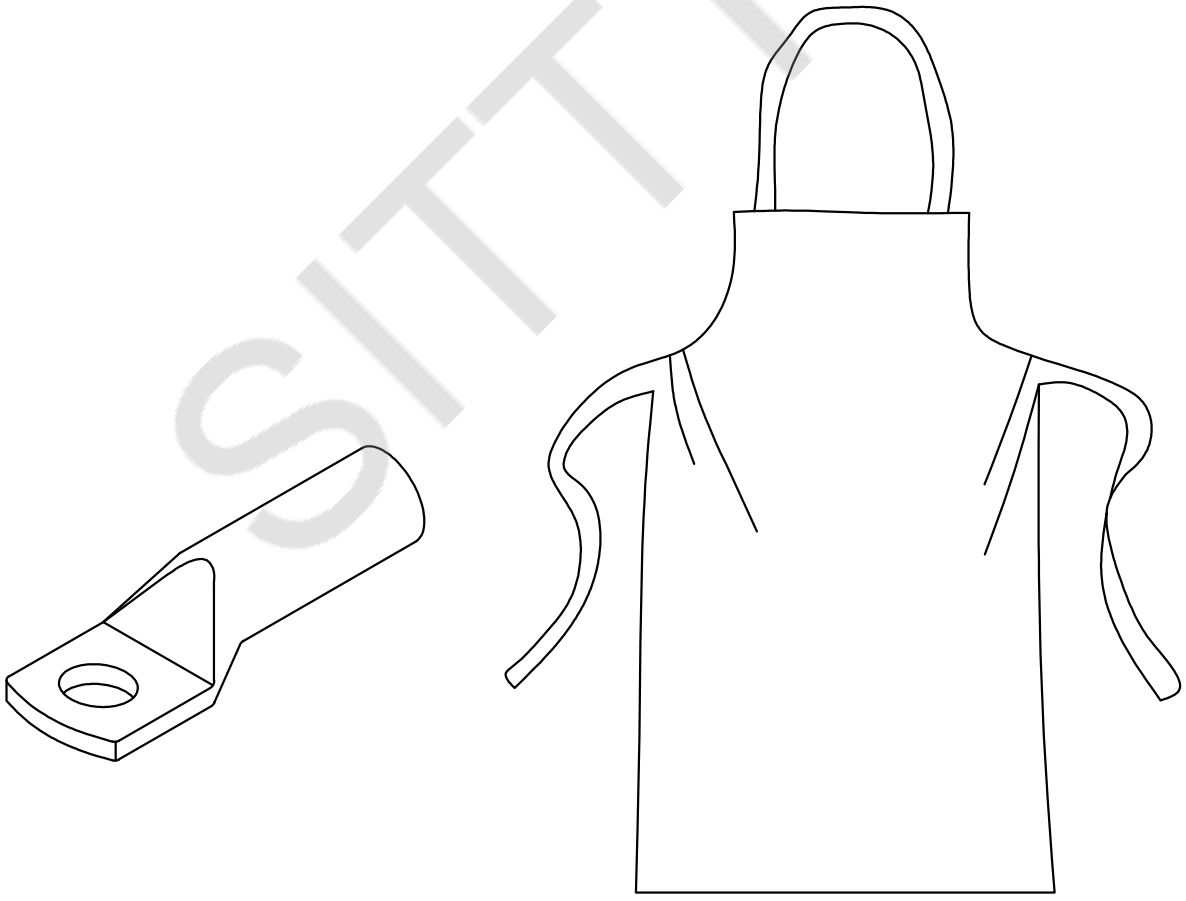
ARC Welding Equipment

The most commonly used equipment for arc welding consists of the following

1. AC or DC machine
2. Electrode
3. Electrode holder
4. Cables and cable connectors
5. Cable Lug
6. Chipping hammer
7. Earthing Clamp
8. Wire Brush
9. Face Shield
10. Hand Gloves
11. Aprons, Sleeves etc.



WIRE BRUSH



CABLE LUG

LEATHER APRON

The welding circuit consists of a power source, two cables, the electrode cable and the ground cables, ground clamp, electrode holder and the electrodes. The two basic types of power supplies for arc welding are the d.c generator and a.c transformer

ARC Welding Machine

Both DC and AC are used for electric arc welding each having its particular applications in some cases either is suitable DC welding supply is usually obtained from generators driven by electric motor. For AC welding supply, transformers are predominantly used for almost all arc welding where mainly electricity supply is available. They have to step down the usual supply voltage (200-400V) to normal circuit welding voltage (50-90V).

A (100-200A) machine is small but portable and satisfactory for light manual welding. A (300 or 400A) big size is suitable for manual welding of average work. Automatic welding requires capacities between (800A and 300 A) either in a single unit or a number of small units in parallel.

Electrodes

It is the usual term or name given to the metallic filler rod used in arc welding to fill up the gap. There are mainly two types of electrode arc used in arc welding process. They are bare wire electrode and coated electrode.

Bare Wire Electrode

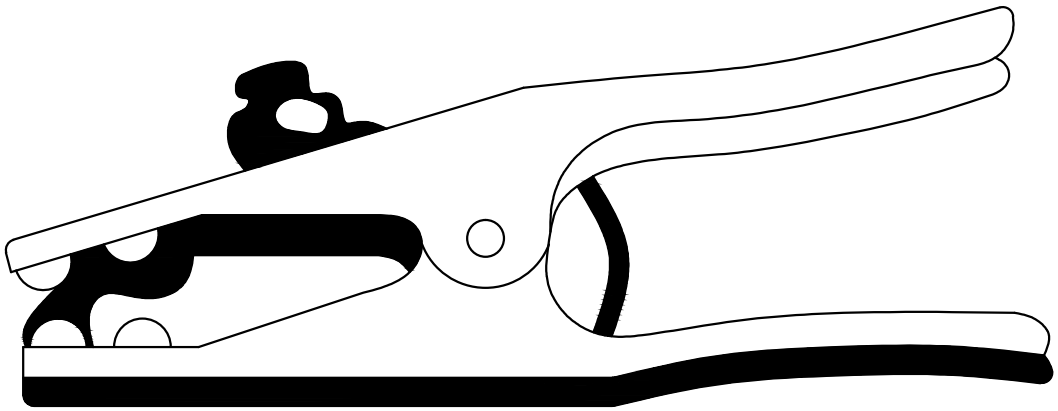
Coated electrode means the original metal wire is coated on covered with a flux compound which contains some chemical substances.

The basic weld movements depend upon the operation of the welding machine. Fig shows the different types of weld movements

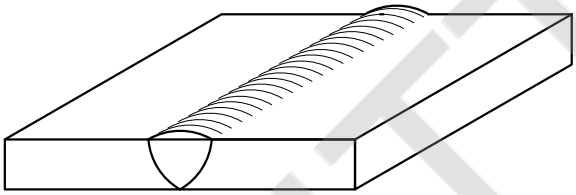
Popular weld movements are the j type of movements, c type of movements, circle and u shaped movement.

Chart for different electrode size and current:

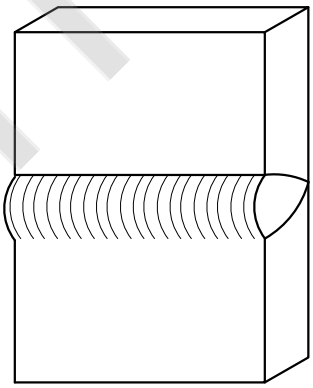
Electrode size in diameter (mm)	Current (amp)
Φ2.00 x 350	50-75
Φ 2.50 x 350	60-90
Φ3.15 x 350	100-140
Φ4.0 x 450	140-180
Φ5.0 x 450	180-230
Φ6.3 x 450	240-300



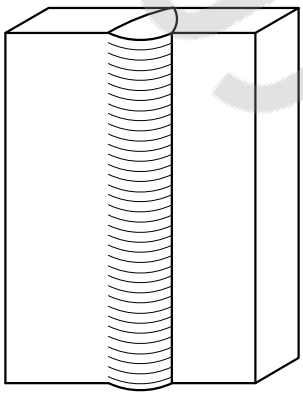
GROUND CLAMP



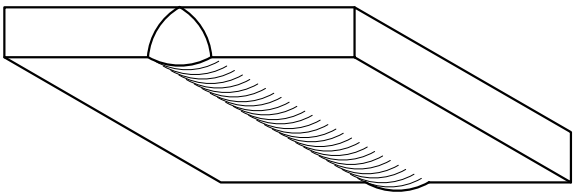
FLAT



HORIZONTAL



VERTICAL



OVERHEAD

WELDING POSITIONS

Welding Tools

1. Electrode Holder

It is fitted at the end of the electrode cable. It should be light in weight and well insulated the holder should have sufficient current carrying capacity.

2. Cables and Cable Connectors

Cables or leads are intended to carry the electric energy from welding machine to work. The cables are flexible and well insulated .the cables are generally made up of copper or aluminum wire. Welding cables are connected by mechanical connectors soldering, welding or brazing. The mechanical connectors are the connection leads that are probably most used because they can be more easily assembled and dismantled.

3. Cable lugs

Cable lugs are used for connecting the cables to the welding machine. One of the cables fastened to the c able lug by means of soldering or pressing

4. Chipping Hammer

A special type of hammer having one end sharpened and the other end flattened. It is used for chipping the slag after welding and it is made with mild steel or high carbon steel.

5. Earthing Clamp or Ground Clamp

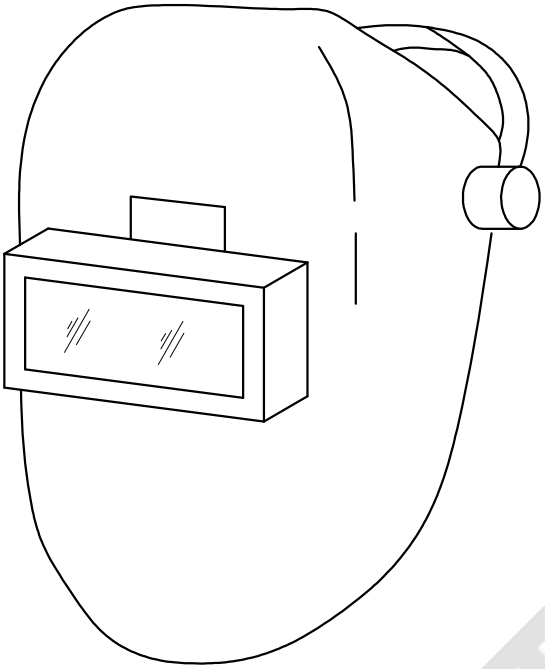
The ground clamp that complete the circuit between the electrode and the welding machine is generally fastened to the metal being welded either with a clamp, a bolt or some other means depending on the size of the metal

6. Wire Brush

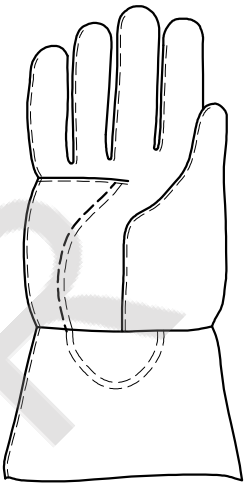
The wire brush, which removes small particles of slag , is generally made of stiff steel wire embedded in wood.

7. Face Shield

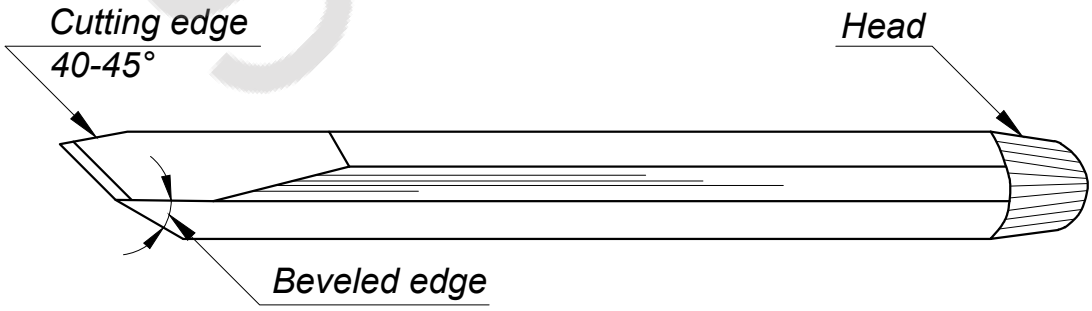
The face shield may be handheld or it may be head helmet with either a slid lens or a flip front. The solid lens is stationary. The flip front lens shading revolves upwards so that the welder can be seeing the weld heading order to clean it. It also allows maximum eye protection from hot slag while chipping. The face shield generally covers the entire face, down to the lower throat which protects eyes from infrared and ultra violet rays. The lens is capable of stopping 99.5% of these rays.



FACE SHIELD



HAND GLOVES



FLAT CHISEL

8. Hand Gloves

Hand gloves are used to protect the hands from the ultra violet and infra red radiations as well as the heat that is given off by the arc column. Hand gloves also protect the hand from minor burns during the chipping operations. The gloves should be worn at all times during the welding process.

9. Aprons

Aprons are two types, asbestos apron and lead limed leather aprons. Apron is also protective clothing used to prevent the hot metal and harmful hot rays attack on the body.

Welding Positions

There are four basic positions in which arc welding can be done: flat, horizontal, vertical and over head of the four. The flat position is the easiest most economical and generally results in the strongest weld joints.

1. Flat Position

In this position the filler metal is deposited from the upper side of the joint with the face of the weld to horizontal.

2. Horizontal Position

In this position, the weld is deposited upon the side of a horizontal and against a vertical surface. if the horizontal welding position is required a shorter. Arc column should be used which is true for the flat position too. A shorter arc column helps to prevent the molten from slagging.

3. Vertical Position

In this position, the lines of welding is I vertical plane and the weld is deposited upon a vertical surface. If the welding is to be done in the vertical position the welder can choose whether to deposit the lead in uphill (top to bottom) or downhill (bottom to top) direction. Downhill welding is much faster than uphill welding. Uphill welding is generally result a stronger welding.

4. Over Head Position

In this position, the weld is deposited from the underside of the joint and the weld is horizontal. It is the reverse of flat welding.

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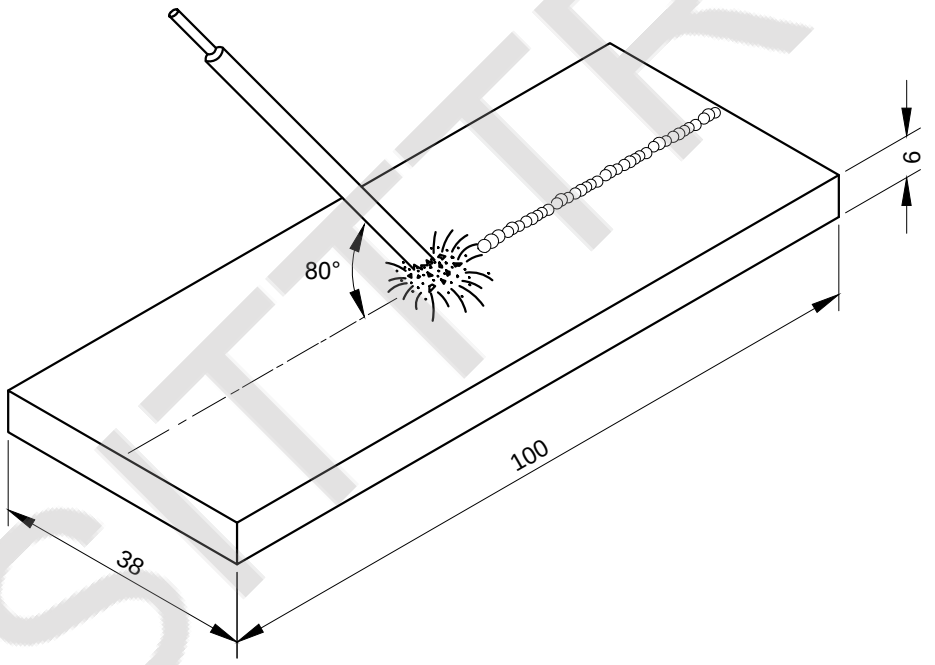
Exercise No.1 Date:

EDGE PREPARATION AND ARC STRIKING PRACTICE



All dimensions are in mm

Exercise No.1 Date:

EDGE PREPARATION AND ARC STRIKING PRACTICE

Aim :

To make a rectangle MS piece as per given dimensions and arc striking practice.

Materials Required :

MS flat 102 x 40 x 6 mm - 1 No.

MS Electrode – Ø3.15mm x 350 mm – 1 No.

Tools and Equipments Required

Steel rule, Try square, scriber, hacksaw, bench vice, flat file, face shield, apron, gloves, tongs, chipping hammer, wire brush, flat chisel and ball peen hammer.

Operations to be Carried Out

Measuring, marking, cutting, holding, filing, checking, setting, arc striking and maintaining, chipping and cleaning.

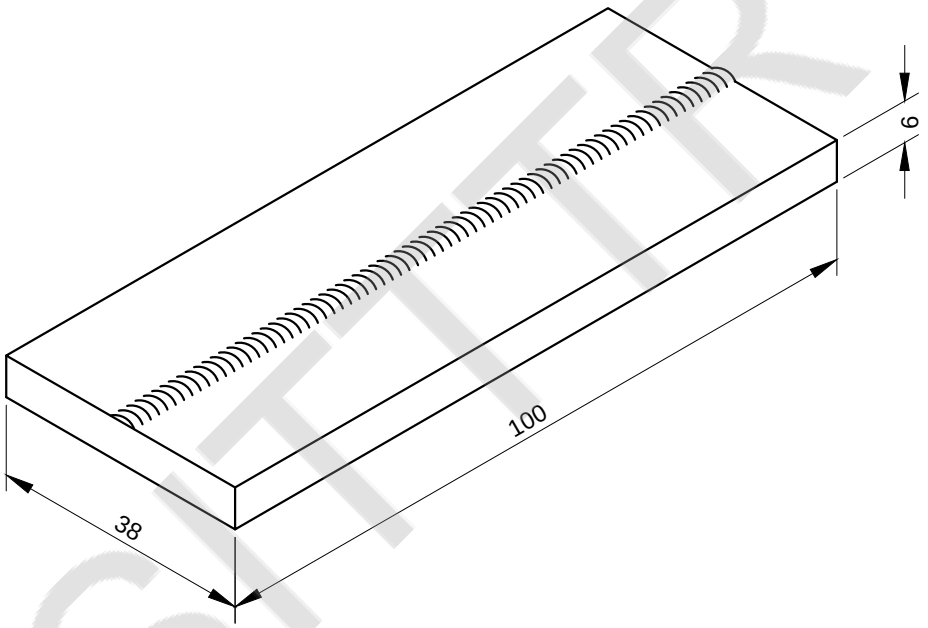
Procedure :

- Measure and mark the MS flat in required dimension with steel rule, try square, scriber
- Cut it with the help of hack saw and bench vice
- Hold the work in bench vice and file the adjacent edges and check the straightness and 90° angle
- Place the work piece on the welding table and switch on the welding machine and set the required current.
- Hold the electrode in the electrode holder and touch the electrode tip on the work piece either scratching or hitting method.
- Strike the arc and maintain it with proper arc length, slow speed and electrode angle.
- Hold the hot work with tongs and allow to cool slowly.
- Chip out the slag and spatters with chipping hammer, chisel and ball peen hammer
- Clean the work by wire brush and subject to visual inspection.

Result :

Exercise No.2 Date:

STRAIGHT LINE WELD DEPOSIT IN DOWN HAND POSITION



All dimensions are in mm

Exercise No.2 Date:

STRAIGHT LINE WELD DEPOSIT IN DOWN HAND POSITION

Aim :

To make a straight line welding in down hand position by arc welding process

Materials Required :

MS flat 102 x 40 x 6 mm - 1 No.

MS Electrode – Ø3.15mm x 350 mm – 1 No.

Tools and Equipments Required :

Steel rule, Try square, scriber, hacksaw, bench vice, flat file, face shield, apron, gloves, tongs, chipping hammer, wire brush, flat chisel and ball peen hammer.

Operations to be Carried Out :

Measuring, marking, cutting, holding, filing, checking, setting, arc striking and maintaining, welding, chipping and cleaning.

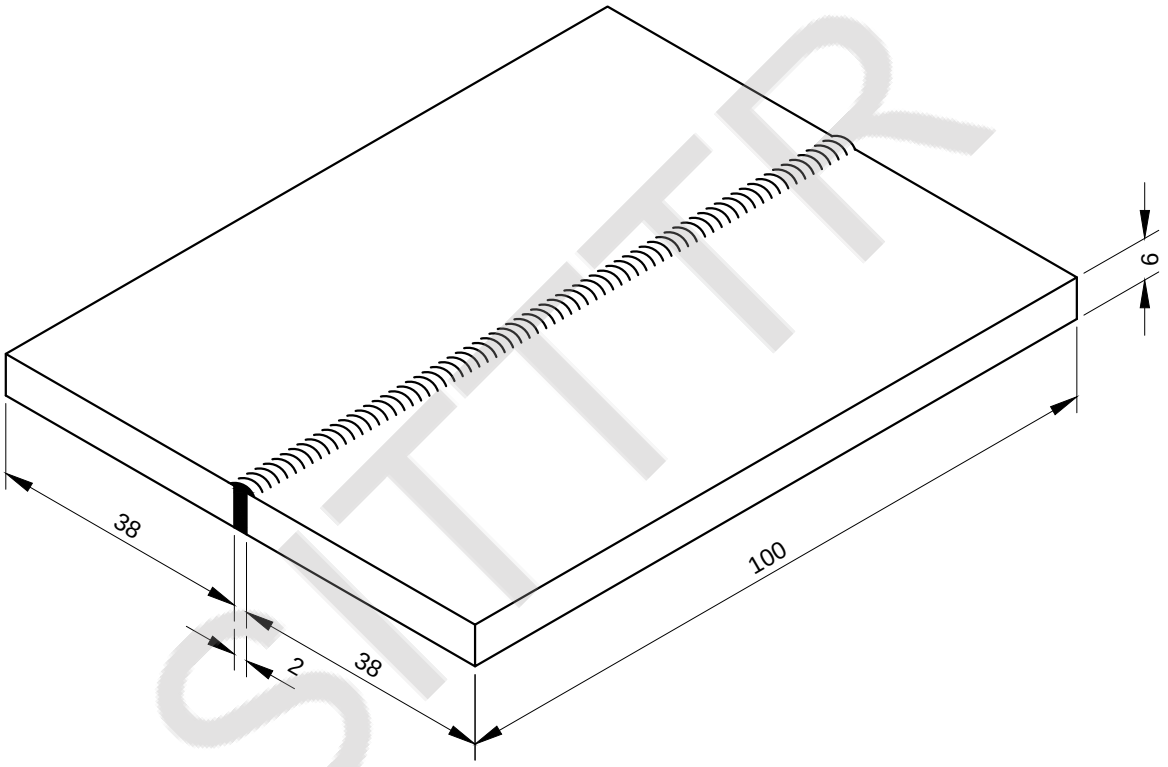
Procedure :

- Mark the required length using a steel rule and a scriber cut the work piece with a hacksaw.
- Hold the work piece in the bench vice and file the length side. Check the level with steel rule.
- File the adjacent side and check the angle with try square. Mark the required width and length then file that side.
- Check the angle with try square and Mark the center and punch through the center line using dot punch and ball peen hammer.
- Put the work piece on the work table and connect the phase cable to the electrode holder and neutral cable to the work.
- Start the AC transformer or DC generator set then Check the ampere before striking the arc according to the diameter of the electrode and Insert the electrode into electrode holder.
- Touch the electrode on the work piece. Then create Arc and maintain that arc up to required length. Remove the slag using a chipping hammer.
- Clean the work with wire brush. Cool the work piece.

Result :

Exercise No.3 Date:

SQUARE BUTT JOINT WELDING



All dimensions are in mm

Exercise No.3 Date:

SQUARE BUTT JOINT WELDING

Aim :

To make a square butt joint welding in down hand position by arc welding process

Materials Required :

MS flat 102 x 40 x 6 mm - 2 No.

MS Electrode – Ø3.15mm x 350 mm – 1 No.

Tools and Equipments Required :

Steel rule, Try square, scriber, hacksaw, bench vice, flat file, face shield, apron, gloves, tongs, chipping hammer, wire brush, flat chisel and ball peen hammer.

Operations to be Carried Out :

Measuring, marking, cutting, holding, filing, checking, setting, tacking, welding, chipping and cleaning.

Procedure :

- Mark the required length using a steel rule and a scriber and Cut the work piece with a hacksaw.
- Hold the work piece in the bench vice and file the length side and Check the level with steel rule.
- File the adjacent side and check the angle with try square and Mark the required width and length then file that sides and check the angle with try square.
- The gap between two work piece are 2 mm. Put the work piece on the work table and connect the phase cable to the electrode holder and neutral cable to the work.
- Start the AC transformer or DC generator set. Then Check the ampere before striking the arc according to the diameter of the electrode and Insert the electrode into electrode holder.
- Tack the work piece and check the levels, Touch the electrode on the work piece. Then create Arc and maintain that arc up to required length. Remove the using a chipping hammer.
- Clean the work with wire brush. Cool the work piece.

Result :

SHEET METAL

SHEET METAL

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO4	**Utilize different sheet metal tools and measuring instruments to make sheet metal joints.**		
M 4.01	i) Explain safety precautions ii) Demonstrate various tools/equipment used in sheet metal shop.	3	Understanding
M 4.02	Demonstrate Sheet Metal operations like sheet Cutting, Bending and Edging.	3	Understanding
M 4.03	Construct Simple joints involving sheet metal operations.	12	Applying

Introduction

Sheet metal has its own significance as a useful trade in engineering and for our day to day requirements. It is generally the working of metals from 16 gauge down to 30 gauge, with simple tools and equipments.

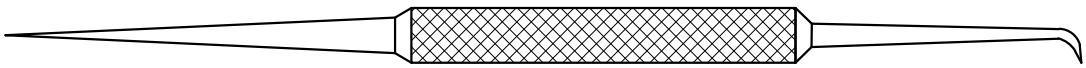
In sheet metal work, the knowledge of geometry, mensuration and properties of metal is most essential since nearly all pattern come from the development of the surfaces of a number of geometrical models such as cylinder, prism, cone and pyramid.

Sheet metal works include various cutting, forming and joining processes in sheet metal. Common examples of sheet metal work are hoppers, canisters, guards, covers, pipes, hoods, funnels, bends, boxes etc. Such articles are found less expensive, lighter in weight and at many places they easily replace the use of the castings or forgings.

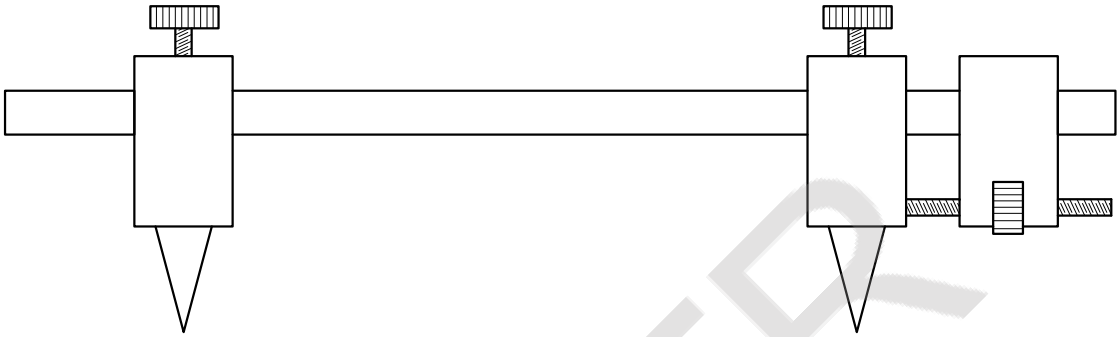
Metals used in sheet metal work

The sheets used in sheet metal work are specified by standard gauge numbers. It is a series of numbers known as standard wire gauge **(SWG)** numbers. Each gauge designates a definite thickness; higher the SWG number of a sheet, lesser will be its thickness. Lower the SWG number, higher the thickness of sheet.

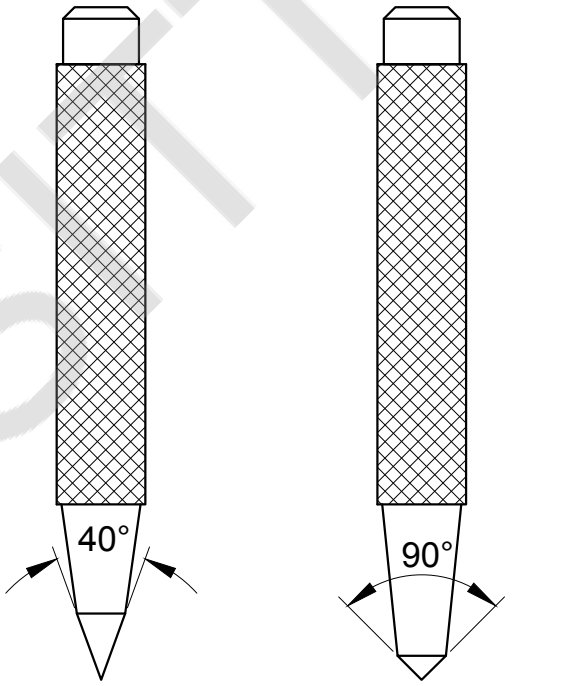
The term ‘sheet’ normally used to describe metal sheets with a maximum thickness of 2 mm; above this, it is usual to use the term ‘plate’.



SCRIBER



TRAMMEL POINTS



Prick Punch *Centre Punch*

PUNCHES

Metal sheets used in sheet metal works are:

Black iron

Black Iron is the cheapest sheet metal and is uncoated. It corrodes rapidly.

Galvanized iron

Zinc coated iron is known as galvanized iron or GI iron.

Stainless steel

This is an alloy of steel with nickel, chromium and traces of other metals, it has good corrosion resistance.

Copper

Copper is a non-ferrous metal and has corrosion resistance property.

Aluminium

Aluminium is a light weight and corrosion resistant metal. It cannot be used in pure form.

Tin plate

Tin plate is iron sheet coated with Tin to prevent corrosion.

Lead

Lead is very soft and heavy. It is used in highly corrosive acid tanks.

Sheet Metal Hand Tools

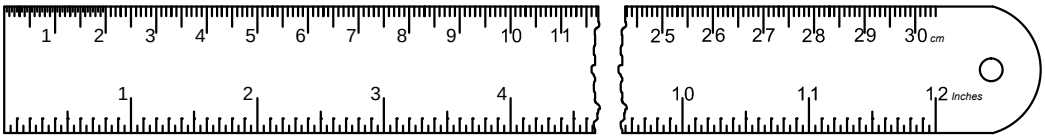
1. Marking Tools

a. Scriber

This is the metal worker's pencil with its one end sharply pointed and hardened to scratch lines on sheet metal in laying out patterns.

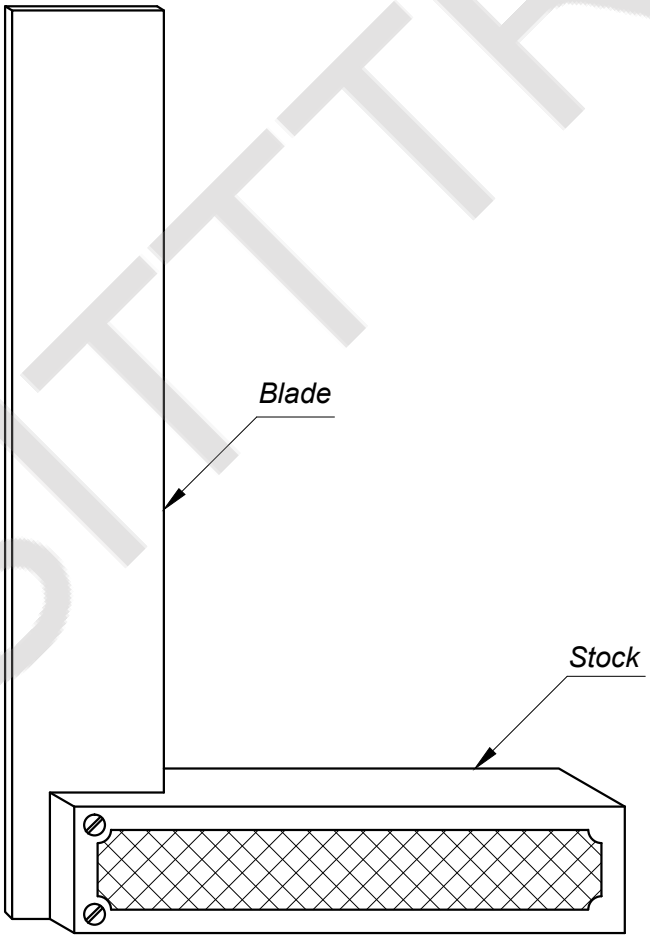
b. Divider

It consists of two pointed legs, and used for drawing circles or arcs or to divide lines into equal parts.



12" = 30.48cm

STEEL RULE



TRY SQUARE

c. Punching Tools

- **Solid Punches** are used for making small holes or markings. Different types of solid punches commonly used are:

  - **Prick punch - 40°**

  - **Centre punch - 90°**

- **Hollow Punches** are also used to punch holes in thin sheet metal, leather, plastic, cork etc.

- **Hand Lever Punch** is used where a large number of holes to be punched.

d. Trammel Points

It consists of a bar with two movable heads. It is used to draw large circles or arcs that are beyond the limit of the dividers.

e. Straight Edge

This is a flat graduated steel bar with one longitudinal edge bevelled. It is useful for scribing long straight lines.

f. Steel Square

It is an L-shaped piece of hardened steel with marks graduated on the edges for measuring, used for marking perpendicular lines to any base line.

g. Try Square

Try square is used for marking in the perpendicular direction to any base line. Main parts are stock and blade.

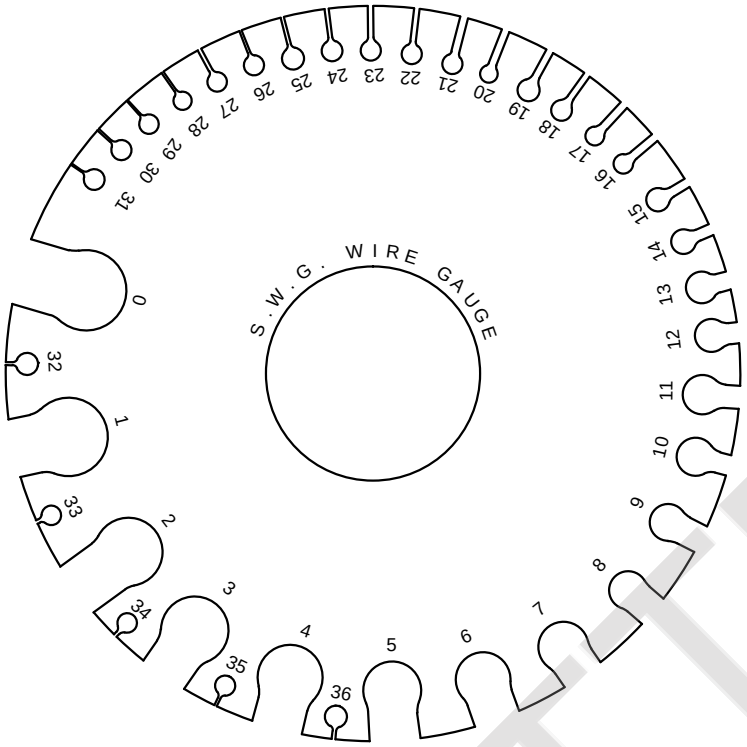
2. Measuring Tools

a. Steel Rule

It consists of a hardened steel strip having graduations etched in it. They are usually 150mm or 300mm long, and is used to take linear measurements to an accuracy of 0.5mm.

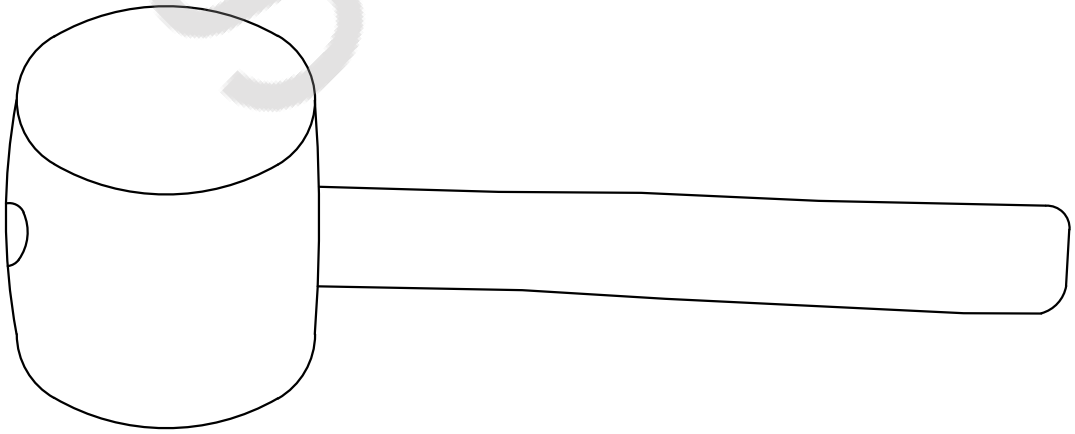
b. Folding Rule

This is useful in measuring and laying out larger works; the accuracy of being 0.5mm. It can be folded in hinges.



Gauge No.	*Approx. thickness (in mm)*
0	7.937
1	7.142
2	6.846
4	5.895
6	4.935
10	3.175
15	1.775
20	0.996
22	0.794
24	0.629
25	0.560
26	0.498
28	0.396
30	0.315
32	0.256
35	0.177

STANDARD WIRE GAUGE



MALLET

c. Circumference Rule

This is used to find out directly the circumference of a cylinder.

d. Bevel protractor

It is used for angular measurement. It consists of a semicircular steel disc graduated in degrees from 0° to 180° and a bevel gauge pivoted centrally.

e. Micrometer

Micrometer is a precision measuring instrument with an accuracy of 0.01mm. Thickness of sheets can be measured by this instrument.

f. Standard Wire Gauge

Both the thickness of the sheet metal and diameter of wires can be checked by means of Standard Wire Gauge.

3. Striking Tools

a. Ball Peen Hammer

It is used useful for rounding off edges of metal pins and fasteners, such as rivets.

b. Setting Hammer

It is used to set up seams, flaring the edge of the cylindrical job and to set up the long channels etc.

c. Riveting Hammer

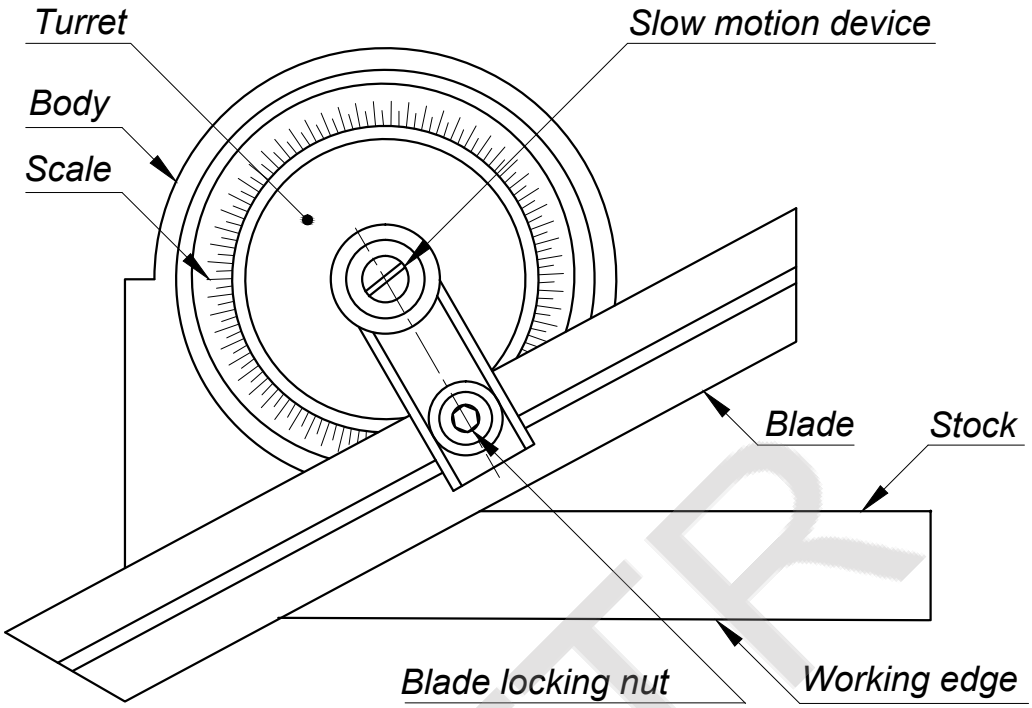
It is used to jump the rivet shanks and finish the rivet heads.

d. Creasing Hammer

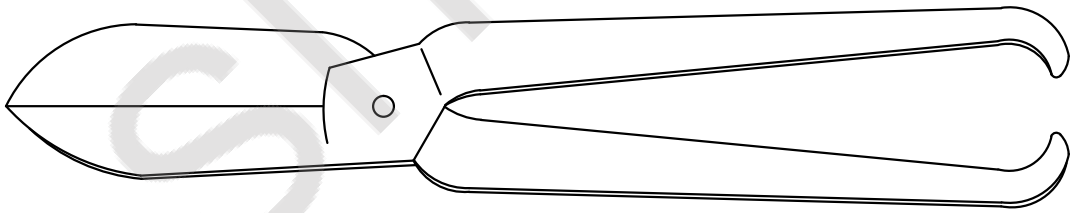
It is used to finish the wired edges, make the corner of the sheets with the help of creasing stake, stretch sheets etc.

e. Raising Hammer

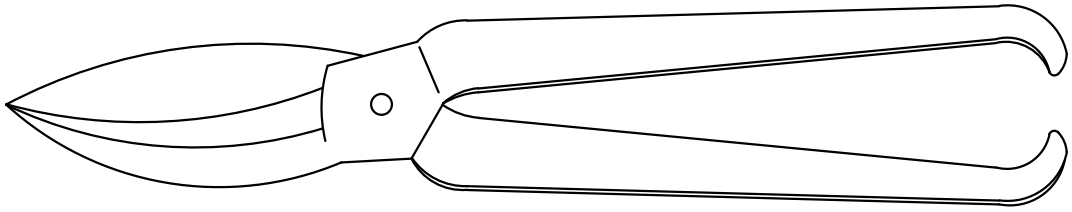
It is used for forming of a flat sheet of metal into a curved or hollow shape such as saucer, bowl, tray or spoon.



BEVEL PROTRACTOR



STRAIGHT SNIPS



BEND SNIPS

f. Planishing Hammer

It is used to give smooth surface finish to the job. Soft nylon hammers are also used to avoid damage to the metal sheet.

g. Mallet

Mallets are soft hammers and are made of hard rubber, copper, brass, lead, fiber or wood. It is used to strike a soft blow on the metal so that nicks will not be made on the surface of the sheet. Types of mallets are; ordinary wooded mallets, bossing mallets and end faked mallets.

4. Supporting Tools

a. Stakes

They are the sheet metal worker's anvil used for bending, seaming or forming operations, using mallet or hammer. It consists of a shank and a head or horn. The shanks are designed to fit into a hole in the bench.

i Hatchet Stake

It consists of a horizontal sharp straight edge and is used for making sharp bends, folding the edges of the sheet metal, forming boxes and pans by hand.

ii Half Moon Stake

It has a sharp edge in the form of an arc of a circle, bevelled along one side. It is used for circular folding and seaming.

iii Funnel Stake

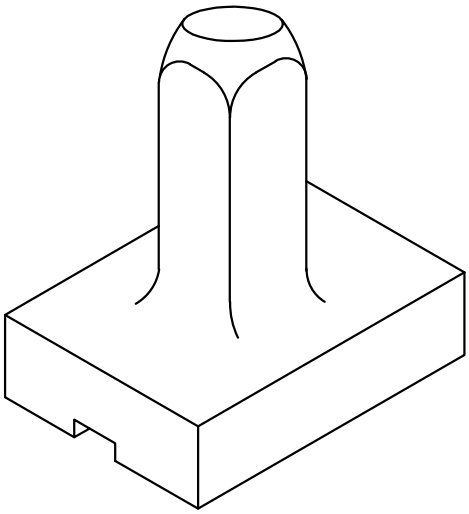
It is used for shaping and seaming of funnels and tapered articles. It is also used to obtain a conical shape in sheet metals for various purposes.

iv Creasing Stake

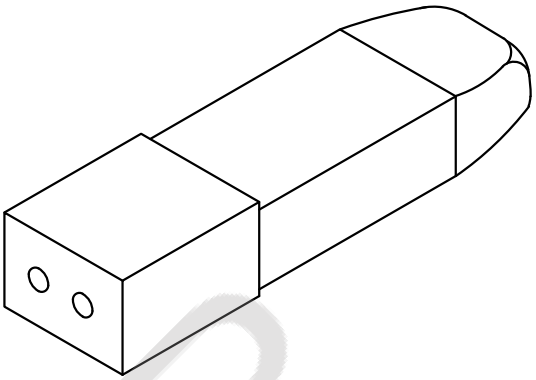
It has a square horn with grooved slots at one end and a tapered round horn at the other end. These are used for wiring and heading and for conical shaped pieces.

v Beak Horn Stake (Bick Iron Stake)

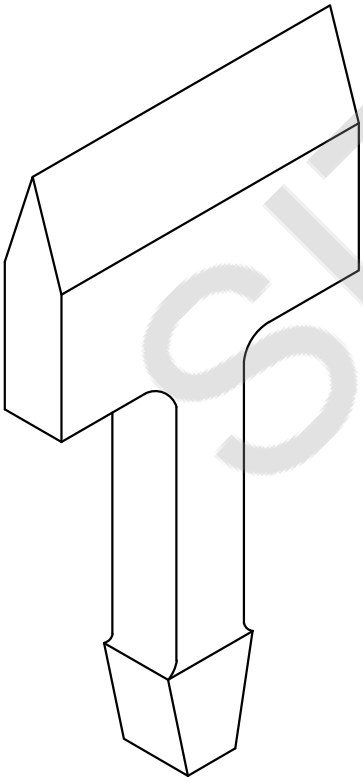
It has two horns, one is tapered and the other is rectangular shaped. It is used as a general purpose anvil, for riveting, forming etc.



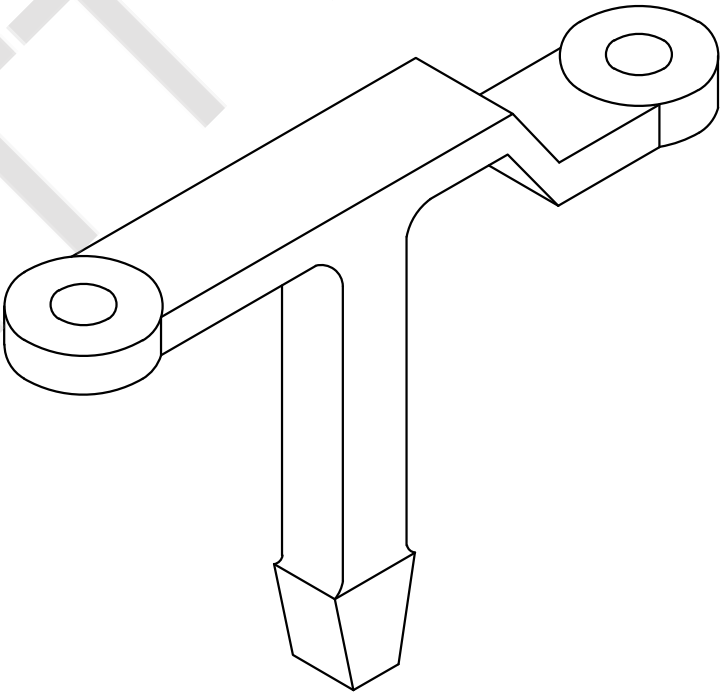
GROOVER



RIVET HEADER



HATCHET STAKE



HORSE STAKE

vi Copper-Smith Stake

It has a rounded edge on one side of the head and a sharp rectangular edge on the other.

vii Conductor Stake

It is having two cylindrical horns of different diameter.

viii Horse Stake

It is double ended holder for small stakes, one of which is cranked downwards for clearance purpose and has square/round holes at both ends.

b. Folding Bars

It is used for bending and folding straight sheet metal held between its bars and clamped to the vice. The folding line coincides with the top of the folding bars.

c. Groover

It is used for closing and locking of seams (joints) in sheet metal work. The end of the tool is recessed to fit over the lock, making the grooved seam.

d. Rivet Set Or Rivet Header

This is a hardened steel tool, hollow in one end. It is used to shape the end of a rivet into a round, smooth end.

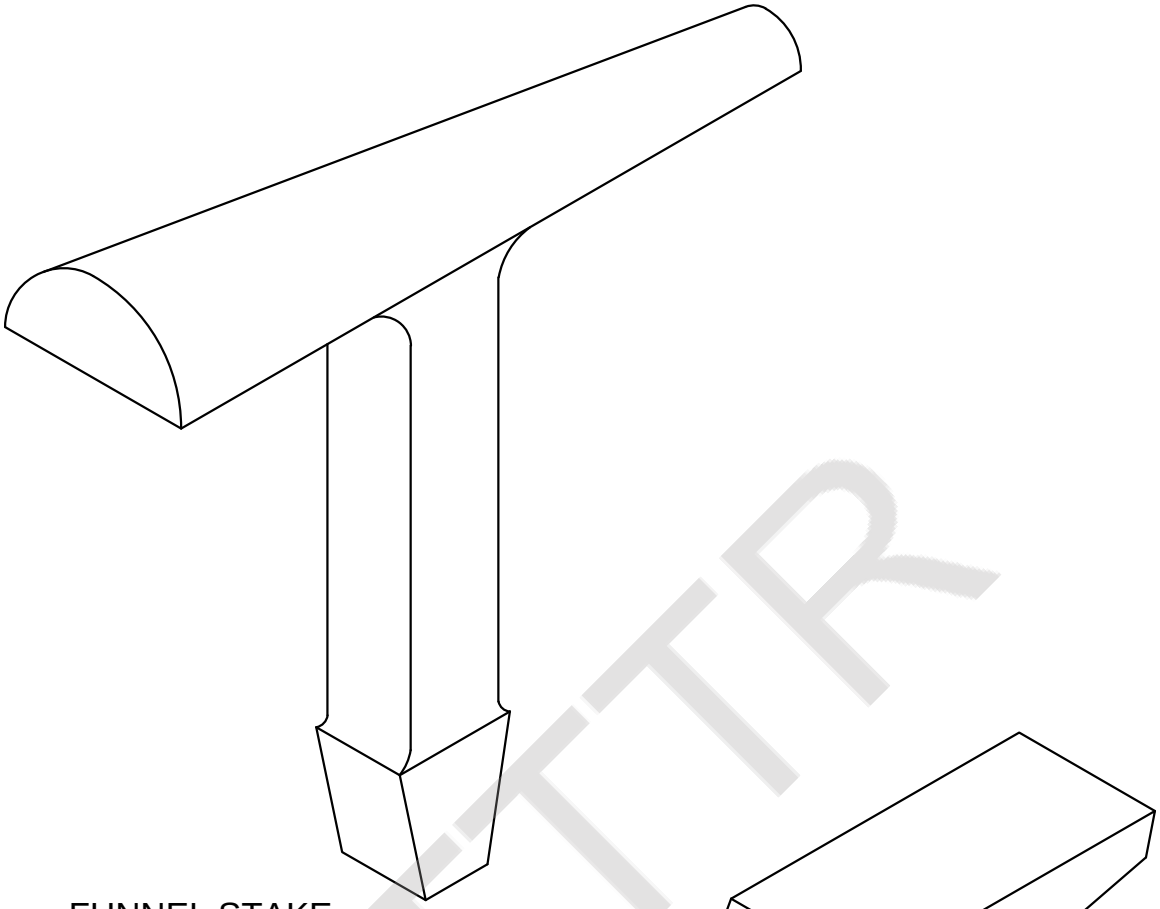
5. Holding Tools

a. Bench Vice

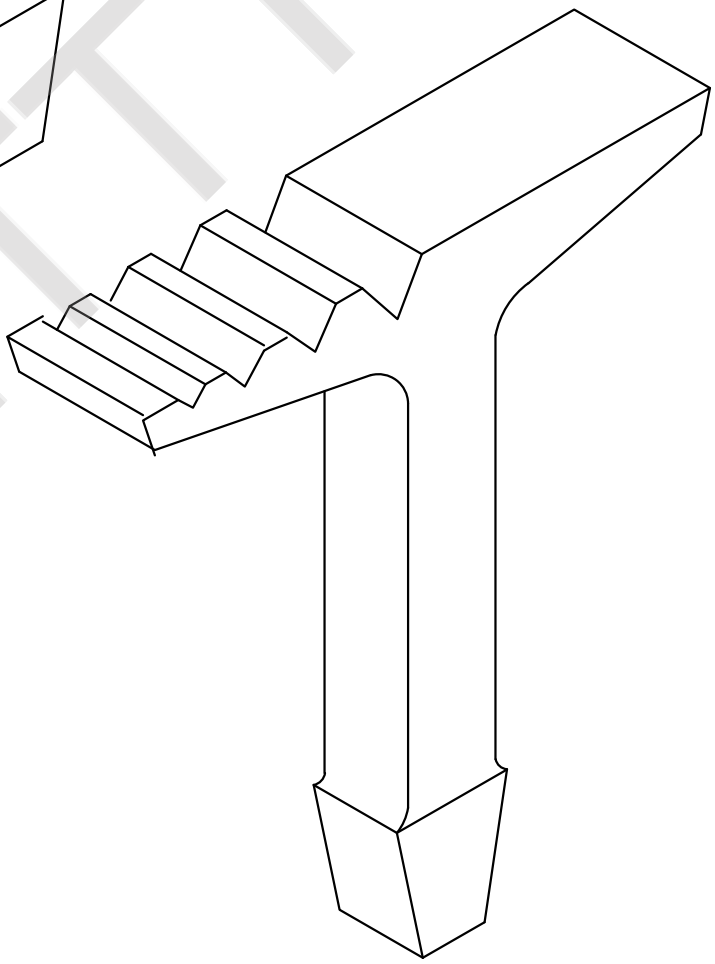
It is made of cast iron or cast steel and is used to hold the work for filing, sawing, threading and other hand operations. The size of the vice is stated by the width of the jaws. It consists of fixed and movable jaws with jaw plates, a lead screw with handle and a base.

b. Pliers

It is used to hold work pieces like wires, small work sheets etc.



FUNNEL STAKE



CREASING STAKE

6. Cutting Tools

a. Snips or Hand Shear

A snip, also called a hand shear is used like a scissors to cut thin, soft metals. It should be used only to cut 20 gauge or thinner metal. These commonly used snipes are: **Straight snips and Bend snips.**

b. Files

A file is a hardened piece of high grade steel with slanting rows of teeth. It is used to cut, smooth, or fit metal parts.

c. Chisels

Chisels are generally used in sheet metal work for cutting sheets, rivets, bolts and chipping operations.

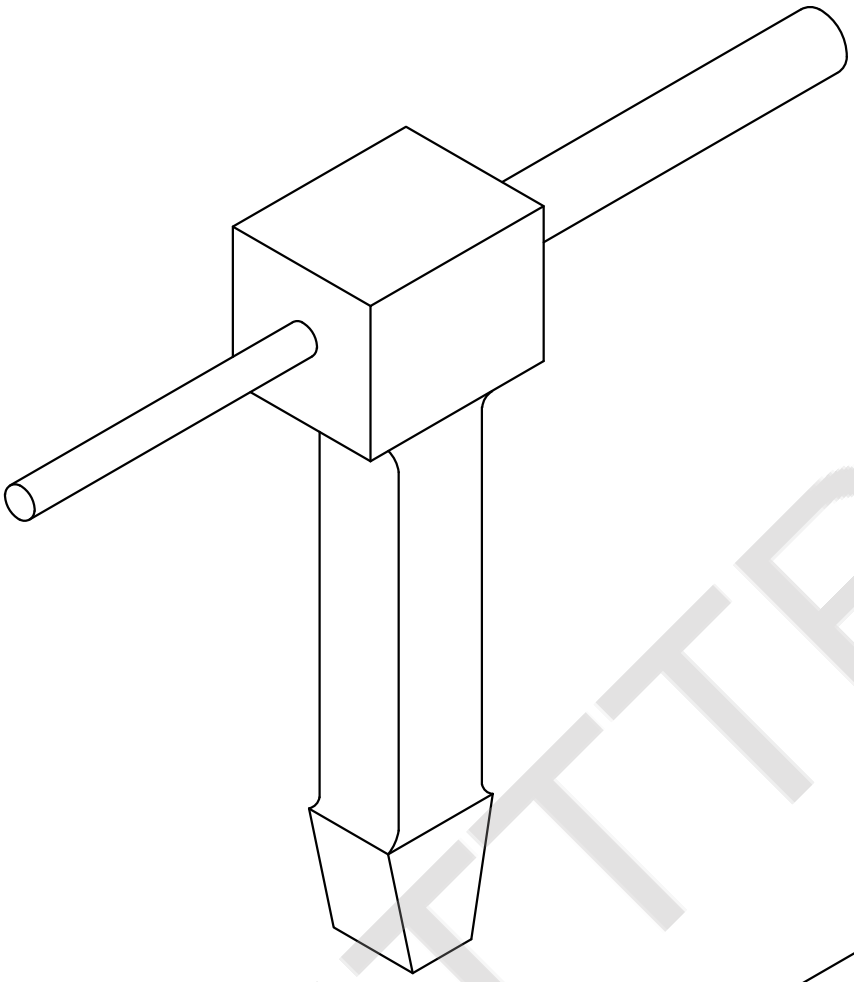
7. Soldering Iron

Soldering iron also called soldering coppers. This is used for soldering work pieces. It consists of a forged piece of copper joined to an iron rod with a wooden handle.

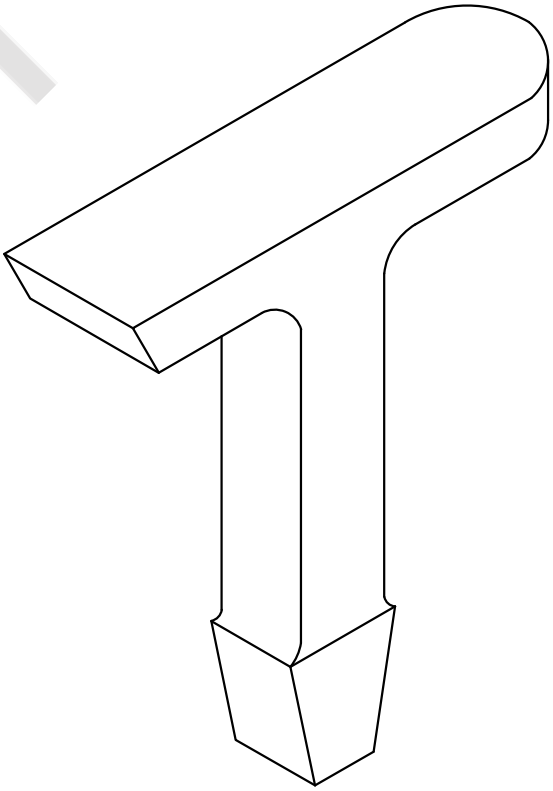
8. Sheet Metal Operations

The practical art of sheet metal lies in the making of different shapes by adopting different operations. The major types of operations are given below:

1. Shearing
   - *Cutting off*
   - *Parting*
   - *Blanking*
   - *Punching*
   - *Piercing*
   - *Notching*
   - *Slitting*
   - *Lancing*
   - *Nibbing*
   - *Trimming*
2. Bending
3. Drawing
4. Squeezing
5. Riveting



CONDUCTOR STAKE



COPPER SMITH STAKE

9. Hems and Seams

a. Hem

Hem is an edge or border made by folding. It stiffens the sheet of metal and does away with sharp edge. Hems are three types; single hem, double hem and wired edge.

b. Seam

A seam is a joint made by fastening two edges together. Seams are lap seam, grooved seam, single seam, double seam, dovetail seam and burred bottom seam.

Sheet Metal Machines

When a large number of jobs are made, particularly in heavier types of sheets, and operations like shearing, punching, bending etc. is difficult, time consuming and uneconomical. To cope with this problem, both hand and power operated machines have been developed. Smaller machines are usually referred as 'bench machine' while the others as 'floor machine' which are particularly useful in mass production of identical parts.

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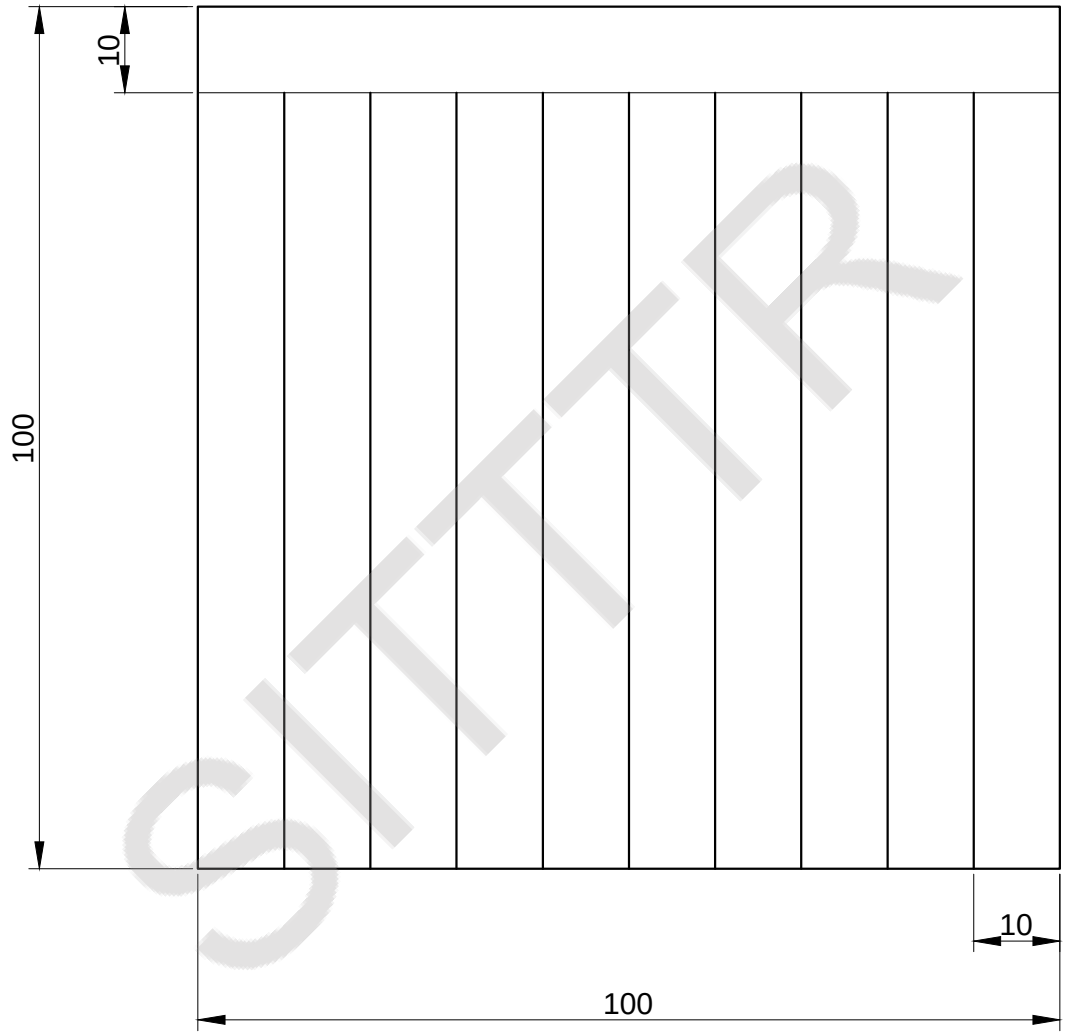
Exercise No.1 Date:

STRAIGHT CUTTING PRACTICE



All dimensions are in mm

Exercise No.1 Date:

STRAIGHT CUTTING PRACTICE

Aim :

To practice, straight cutting in the given work piece as per drawing.

Materials Required :

GI sheet of 26 SWG – size 102x102 mm.

Tools Required :

Steel rule, Scriber, Try square, Flat file, Mallet, Straight snips, stakes etc.

Operations to be Carried Out :

Measuring, marking, filing, cutting, levelling, checking and finishing.

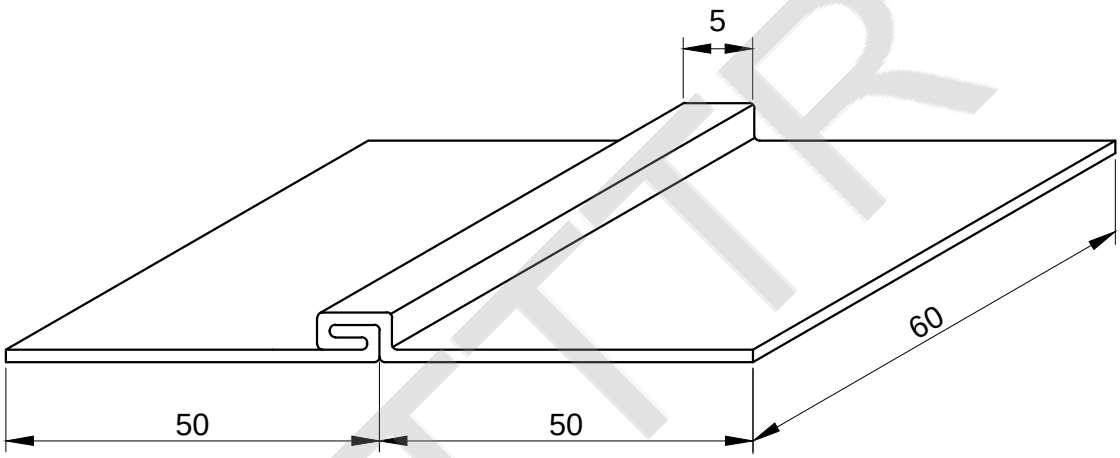
Procedure :

- Mark the given work piece as per dimensions with the help of steel rule, try square and scriber.
- File the edges and size it into 100x100mm.
- Cut the sheet through the lines marked 10mm apart, as per drawing using straight snips.
- Level the strips with mallet.
- Check and finish the work.

Result :

Exercise No.2 Date:

LOCKED GROOVED JOINT



All dimensions are in mm

Exercise No.2 Date:

LOCKED GROOVED JOINT

Aim :

To make a locked grooved joint as per drawing.

Materials Required :

GI sheet of 26 SWG – size 117x62 mm

Tools Required :

Steel rule, Scriber, Try square, Flat file, Mallet, Straight snips, Groover, Ball peen hammer, stakes etc.

Operations to be Carried Out:

Measuring, marking, cutting, levelling, filing, folding, locking or grooving, checking and finishing.

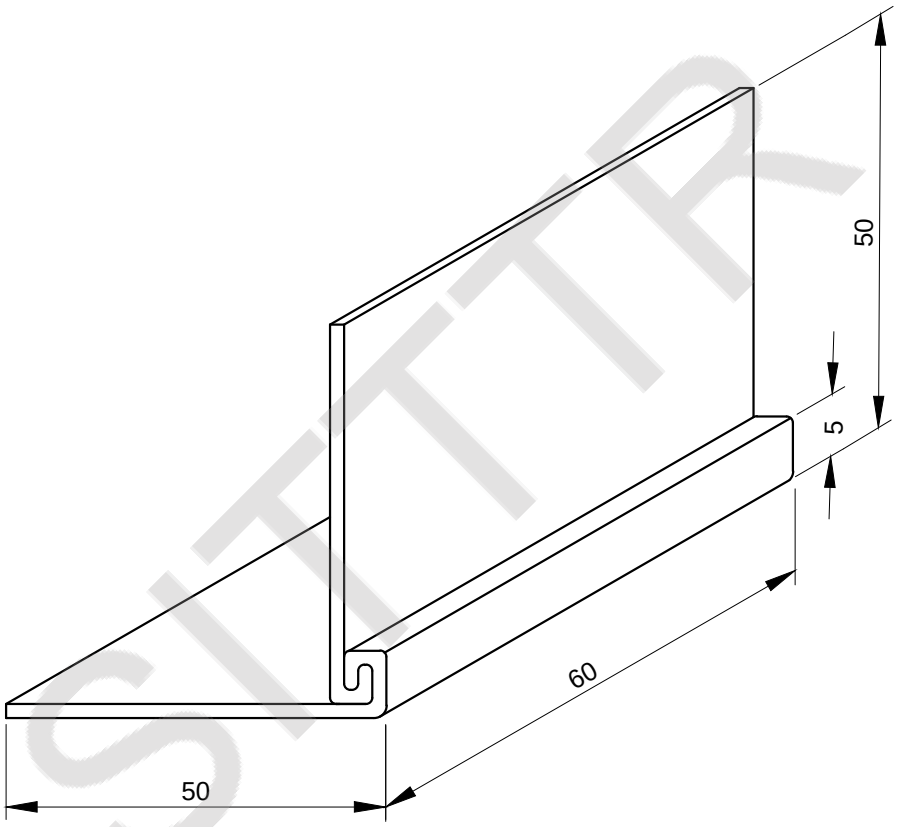
Procedure :

- Mark the given work piece as per dimensions with the help of steel rule, try square and scriber.
- Cut two pieces from the given work piece as per dimensions.
- File the edges and size it to required dimensions.
- Fold one of the edges of each plate in 5mm width and hook it together by using bench vice and mallet.
- Lock the seam with groover and hammer to form a locked grooved joint.
- Level, check and finish the work.

Result :

Exercise No.3 Date:

PANED DOWN & KNOCKED UP JOINT



All dimensions are in mm

Exercise No.3 Date:

PANED DOWN & KNOCKED UP JOINT

Aim :

To make a paned down and knocked up joint as per drawing.

Materials Required :

GI sheet of 26 SWG – size 117x62 mm.

Tools Required :

Steel rule, Scriber, Try square, Flat file, Mallet, Straight snips, stakes etc.

Operations to be Carried Out :

Measuring, marking, cutting, levelling, filing, folding, locking, checking and finishing.

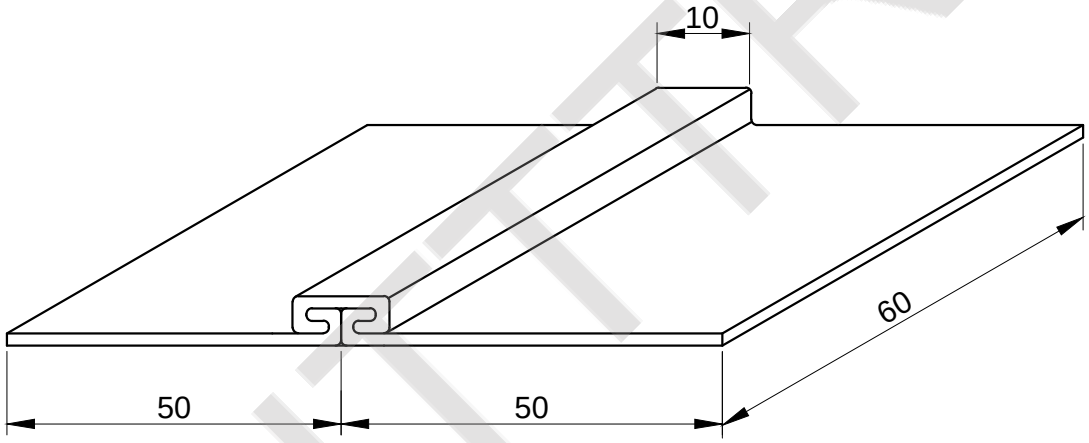
Procedure :

- Mark the given work piece as per dimensions with the help of steel rule, try square and scriber.
- Cut two pieces from the given work piece as per dimensions.
- File the edges and size it to required dimensions.
- Fold one of the edges of each plate in 5mm width and hook it together perpendicularly by using bench vice and mallet.
- Lock the seam by striking with mallet to form a paned down joint.
- Bend the locked seam portion upwards to lock the joint there by forming a knocked up joint.
- Level, check and finish the work.

Result :

Exercise No.4 Date:

DOUBLE GROOVED JOINT



All dimensions are in mm

Exercise No.4 Date:

DOUBLE GROOVED JOINT

Aim :

To make a double grooved joint as per drawing.

Materials Required :

GI sheet of 26 SWG – size 132x62 mm.

Tools Required :

Steel rule, Scriber, Try square, Flat file, Mallet, Straight snips, stakes etc.

Operations to be Carried Out :

Measuring, marking, cutting, levelling, filing, folding, locking, checking and finishing.

Procedure :

- Mark the given work piece as per dimensions with the help of steel rule, try square and scriber.
- Cut three pieces from the given work piece as per dimensions.
- File the edges and size it to required dimensions.
- Fold one of the edges of each plate in 5mm width to match with the strap plate edge which is to be folded 5mm in both ends.
- Hook the strap plate with folded edges of other plates to form double locked joint.
- Lock the seam with mallet to form a double locked joint.
- Level, check and finish the work.

Result :

ELECTRICAL WIRING AND SOLDERING

ELECTRICAL

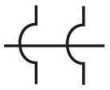
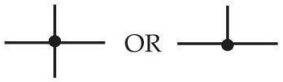
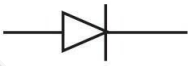
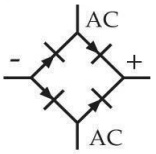
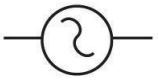
Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO5	**Make use of various tools and accessories to practice electrical wiring, motor connection and soldering**		
M5.01	i) Explain safety precautions ii) Demonstrate various tools and accessories required for Electrical wiring.	3	Understanding
M5.02	Explain wiring materials generally used.	3	Understanding
M5.03	Develop a circuit and wire up to control one lamp by one switch in conduit wiring.	3	Applying
M5.04	i) Develop a circuit and wire up for stair case for one lamp by two switches. ii) Make a connection of single phase /three phase induction motor with DOL starter.	6	Applying
M5.05	Demonstrate soldering iron and flex. Make simple circuit using soldering of electrical/ electronic components.	3	Applying

Electrical safety precautions:

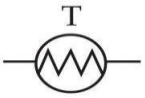
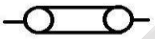
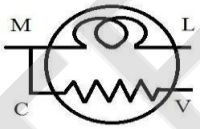
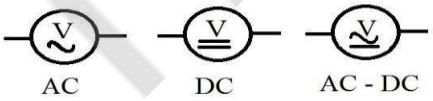
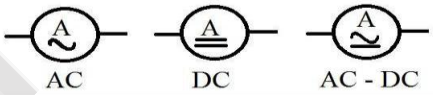
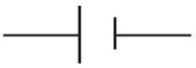
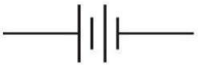
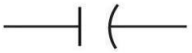
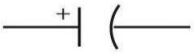
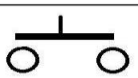
1. Avoid contact with energized electrical circuits.
2. Disconnect the power source before servicing or repairing electrical equipment.
3. When it is necessary to handle equipment that is plugged in, be sure hands are dry and, when possible, wear nonconductive gloves and shoes with insulated soles.
4. If it is not unsafe to do so, work with only one hand, keeping the other hand at your side or in your pocket, away from all conductive material. This precaution reduces the likelihood of accidents that result in current passing through the chest cavity.
5. If water or a chemical is spilled onto equipment, shut off power at the main switch or circuit breaker and unplug the equipment.
6. If an individual comes in contact with a live electrical conductor, do not touch the equipment, cord or person. Disconnect the power source from the circuit breaker or pull out the plug using a leather belt.
7. Do not make circuit changes or perform any wiring when power is on.

8. Do not wear loose-fitting clothing or jewellery in the lab. Rings and necklaces are usual excellent conductors in contact with your skin.
9. It is wise in electrical labs to wear pants rather than shorts or skirts.
10. Powered equipment can be hot! Use caution when handling equipment after it has been operating.
11. Do your wiring, setup, and a careful circuit checkout before applying power.
12. Use wires of appropriate length. Do not allow them to drape over your equipment.
13. Do not pull wires out until you are absolutely sure that the circuit is completely dead. Shocks can occur if an inductive load (motor or transformer) is disconnected while conducting.
14. All the electrical equipment must be connected to the proper earth line.
15. All high voltage equipment must properly be marked and danger signs displayed.
16. If you are working on high voltage circuits, have a co-worker along with you who knows how to break the circuit to get you free and how to give you mouth-to-mouth resuscitation and closed chest heart massage.
17. When you are mentally or physically tired, avoid work on energized circuits.

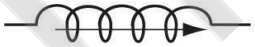
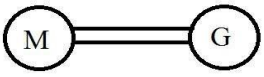
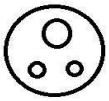
Electrical Symbols

COMPONENT	SYMBOL
CROSS, NO CONNECTION	
CONNECTION	
FAULT	
CONNECTION, EARTH GROUND	
CONNECTOR	
DIODE, SEMICONDUCTOR	
FULL-WAVE, BRIDGE-TYPE RECTIFIER	
FUSE	
AC GENERATOR	
DC GENERATOR	
HEATER	

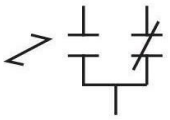
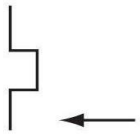
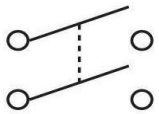
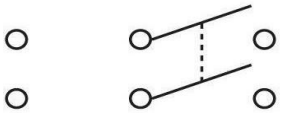
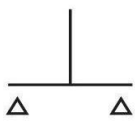
Electrical Symbols

COMPONENT	SYMBOL
TERMINAL	
TRANSFORMER, IRON CORE	
THERMISTOR	
NEUTRAL LINK	
WATT METER	
V - VOLTMETER	
AMMETER	
BATTERY (LONG LINE IS ALWAYS POSITIVE)	
SINGLE CELL	
MULTICELL	
CAPACITOR FIXED	
POLARIZED	
CIRCUIT BREAKER	
CONTACTS NORMALLY CLOSED	
NORMALLY OPEN	

Electrical Symbols

COMPONENT	SYMBOL
IGNITORS SPARK IGNITOR, GROUNDED	
SPARK IGNITOR, UNGROUNDED	
GLOW COIL; GLOW BAR; HOT WIRE	
INDUCTOR (COIL)	
INDUCTOR (SOLENOID)	
LAMP	
MOTOR, AC	
MOTOR, DC	
OHMMETER	
MOTOR - GENERATOR SET	
THREE PIN PLUG SOCKET	
TWO PIN PLUG SOCKET	

Electrical Symbols

COMPONENT	SYMBOL
RELAY WITH TRANSFER CONTACTS	
THERMAL OPERATION RELAY WITH NORMALLY OPEN CONTACTS	
THERMAL OPERATION RELAY WITH NORMALLY CLOSED CONTACTS	
RESISTOR FIXED	
VARIABLE	
SWITCHES SINGLE-POLE-SINGLE THROW (SPST)	
SINGLE-POLE-DOUBLE THROW (SPDT)	
DOUBLE-POLE-SINGLE THROW (DPST)	
DOUBLE-POLE-DOUBLE THROW (DPDT)	
PUSH BUTTON MOMENTARY NORMALLY CLOSED (PBNC)	
PUSH BUTTON MOMENTARY NORMALLY OPEN (PBNO)	

Electrical Wiring Tools

1. **Screw driver:**

   It is used to turn, tighten or remove screws.

2. **Ratchet:**

   It is used to allow rotary motion in only one direction and preventing the motion in opposite direction. It is used to tighten nuts of various sizes.

3. **Wire cutter and plier:**

   A wire cutter is used for striping and cutting wires whereas a plier is used to hold objects like nuts and bolts firmly also used for cutting metal wires.

4. **Tester:**

   It is used to verify the presence of electric voltage in electrical equipment.

5. **Crimping tool:**

   It is used to cut various objects such as wires, cords, tapes and so on. It is also used to join wires with metal or plastic objects.

6. **Voltmeter:**

   It is used to measure potential difference between two points in the electric circuit.

7. **Ammeter:**

   It is used to measure current flow in a circuit.

8. **Watt meter:**

   It is used to measure electrical power of any given circuit (in watts).

9. **Megger or Megohmmeter:**

   It is used to measure leakage in wires and earth resistance.

10. **Multimeter:**

    It is used to measure various electrical quantities like resistance, voltage, current, etc.

11. **Energy Meter:**

    The meter which is used for measuring the energy utilises by the electric load is known as the energy meter. The energy is the total power consumed and utilised by the load at a particular interval of time. It is used in domestic and industrial AC circuit for measuring the power consumption.

TOOLS

SIDE CUTTING PLIER

NOSE PLIER

COMBINATION PLIER

SCREW DRIVER

CRIMBING TOOL

STAR

LINE TESTER

WIRE STRIPPER

MEASUREMENT TAPE

GIMLET

DRILLING MACHINE

12. Combination Pliers

It is used for cutting, removing insulation, jointing and twisting the electric wires and cables even on live-line. A lineman's pliers have special design, which multiplies force through leverage. These pliers usually have grips for better handling than bare metal handles. The grips also have insulation for protection against electric shock when working with live circuits. A lineman's pliers are typically machined from forged steel. The two handles are precisely joined with a heavy-duty rivet that maintains the pliers' accuracy even after repeated use under extreme force on heavy gauge wire.

13. Electric Drilling Machine

It has the below mentioned properties: It is a portable electric powered tool used for drilling the surface. It has a high speed motor to revolve the chuck. It is used to make holes smoothly and easily.

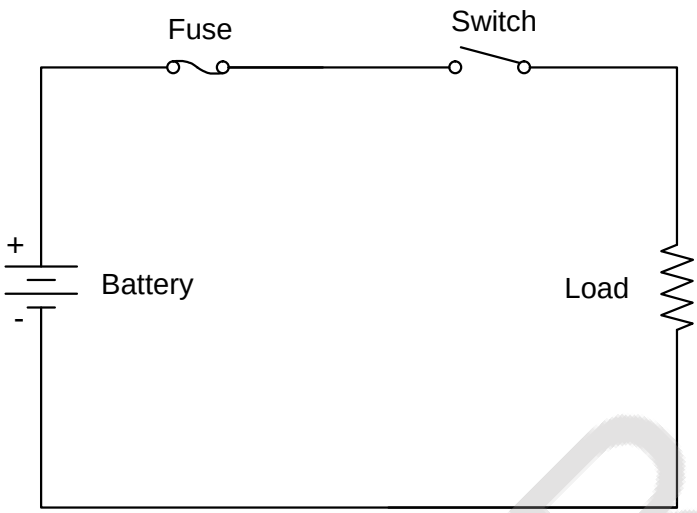


Fig.1

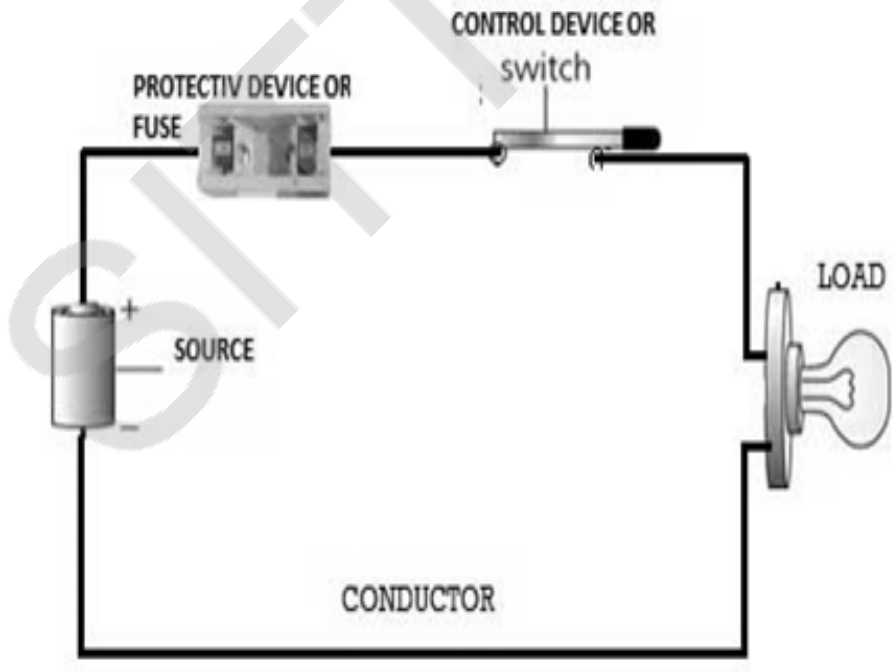


Fig.2

Electric circuit

An electric circuit is defined as the network of different components such as battery, lamp, switch etc which facilitate current flow. Fig.1 and Fig.2 shows simple electric circuits.

Generally an electric circuit may have five components as listed below.

1. The power source. or battery.
2. Load.
3. Conductors.
4. Control devices.
5. Protective devices.

Human Sensitivity to Electricity

500mA – Immediate cardiac arrest resulting in death.

70-100mA – Cardiac fibrillation; the heart begins beats at a steady.

20-30mA – Muscle contraction can cause respiratory paralysis.

10mA – Muscle contraction; the person remains stuck, to the conductor.

1-9mA – Prickling sensation

WIRING MATERIALS

PENDENT HOLDER

STEADY BATTEN HOLDER

GANG BOX

ROUND BLOCK

CEILING ROSE

ELBOW

3WAY JUNCTION BOX

4WAY JUNCTION BOX

DP SWITCH

TEE

BEND

SADDLE

TWO PIN PLUG

THREE PIN PLUG

THREE PIN SOCKET

TWO PIN SOCKET

Electrical wiring accessories

Wiring accessories are used for connecting appliances

1. Switch

A switch is used to make or break an electrical circuit. It is used to switch 'on' or 'off ' the supply of electricity to an appliance. There are various switches

a. Surface switch:

It is mounted on wooden boards fixed on the surface of a wall. It is of three types

1. One-way switch 2. Two-way switch 3. Intermediate switch

One-way switch : It is used to control single circuits and lamp

Two-way switch : It is used to divert the flow of current to either of two directions. The two-way switch can also be used to control one lamp from two different places as in the case of staircase wiring

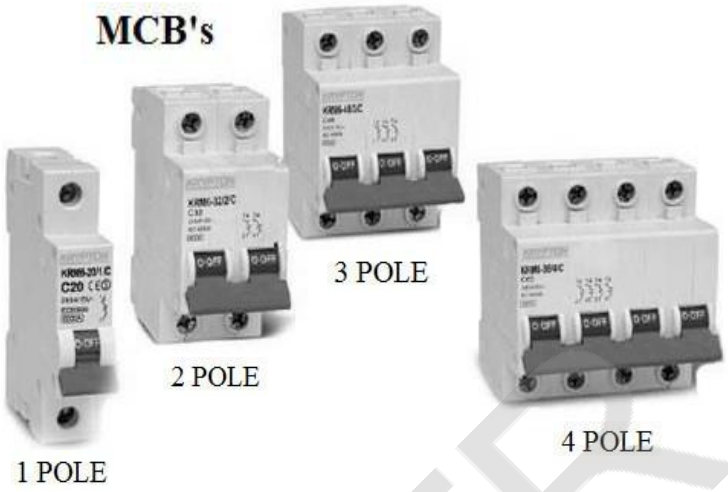
Intermediate switch: It is used to control a lamp from more than two locations

b. Flush switch:

It used for decorative purpose

c. Bed switch:

As the name indicates, it is used to switch 'on' the light from any place, other than switch board or from near the bed. This switch is connected through a flexible wire.



FUSE CARRIER
WITH TOP

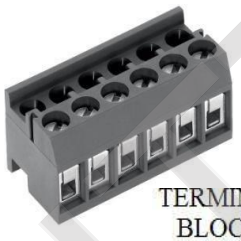
CHOKE

ONE WAY
SWITCH

TWO WAY
SWITCH

I.C.D.P MS

I.C.T.P MS



TERMINAL BLOCK

STARTER

ELCB's

1 PHASE 3 PHASE

Voltmeter

Ammeter

Megger

Multimeter

Energy meter

Wattmeter

2. Holders

A holder is a device used for holding lamps firmly.

They are two types.

1. Pendant holder 2. Batten holder

3. Ceiling Rose

It is used to provide a tapping to the pendant lamp– holder through the flexible wire or a connection to a fluorescent tube.

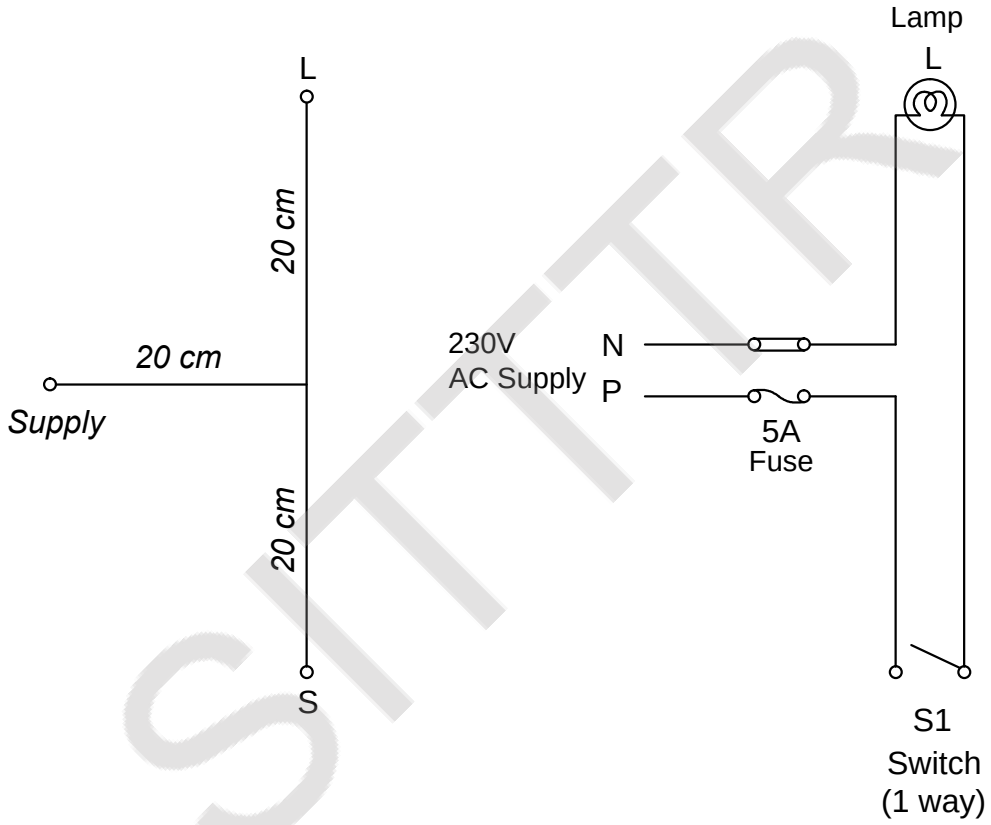
4. Socket Outlet/Plug

The socket outlet has an insulated base with the moulded or socket base having three terminal sleeves.

****

Exercise No.1 Date:

ONE LAMP CONTROLLED BY ONE SWITCH



LAYOUT CIRCUIT DIAGRAM

Exercise No.1 Date:

ONE LAMP CONTROLLED BY ONE SWITCH

Aim :

To wire up a circuit one lamp controlled by one switch in conduit wiring system.

Tools required:

Sl no	Name of tool & Specification	Quantity	Remarks
1	Screw driver 200mm	1	
2	Line tester 500V(neon)	1	
3	Cutting pliers 150mm(insulated)	1	
4	Combination pliers 150mm	1	
5	Hammer(ball peen)225gm	1	
6	Pocker150mm	1	
7	Firmer chisel 25mm	1	
8	Hack saw 300mm	1	

Materials required:

Sl. No.	Name of materials & Specifications	Quantity	Remarks

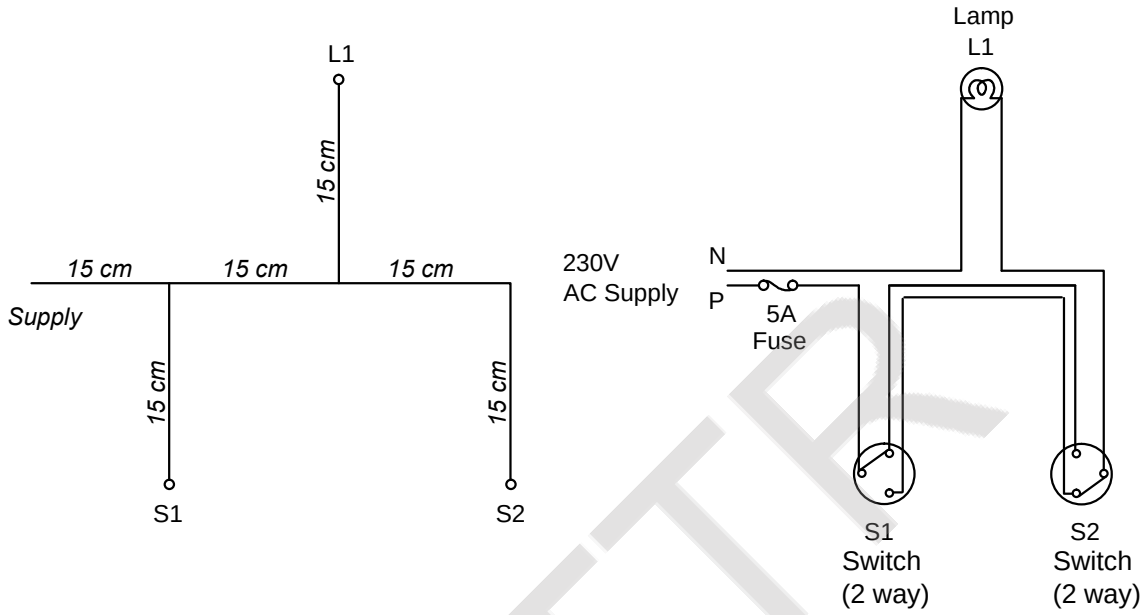
Procedure:

1. Draw layout on the wiring board.
2. According to the layout, fix 20mm conduit on the board using saddles.
3. Draw cables through the conduit and connect as per connection diagram.
4. Fix lamp holder and switch on round block.
5. Give the specified supply and verify lamp status for different positions of switches.

Result :

Exercise No.2 Date:

STAIR CASE WIRING



LAYOUT CIRCUIT DIAGRAM

STATUS TABLE

Sl.no.	S1	S2	L1
1	↑	↑	OFF
2	↑	↓	ON
3	↓	↓	OFF
4	↓	↑	ON

S1 & S2 – Two way switches

Exercise No.2 Date:

STAIR CASE WIRING

Aim

1. Prepare an estimate to carry out PVC Surface conduit wiring as per the given layout, to control one lamp from two different places by two switches independently.
2. Carry out wiring on the wiring board.

Tools required

Sl no	Name of tool &specification	Quantity	Remarks
1	Screw driver 200mm	1	
2	Line tester 500V(neon)	1	
3	Cutting pliers 150mm(insulated)	1	
4	Combination pliers 150mm	1	
5	Hammer(ball peen)225gm	1	
6	Pocker150mm	1	
7	Firmer chisel 25mm	1	
8	Hack saw 300mm	1	

Materials required

Sl. No.	Name of materials & specifications	Quantity	Remarks

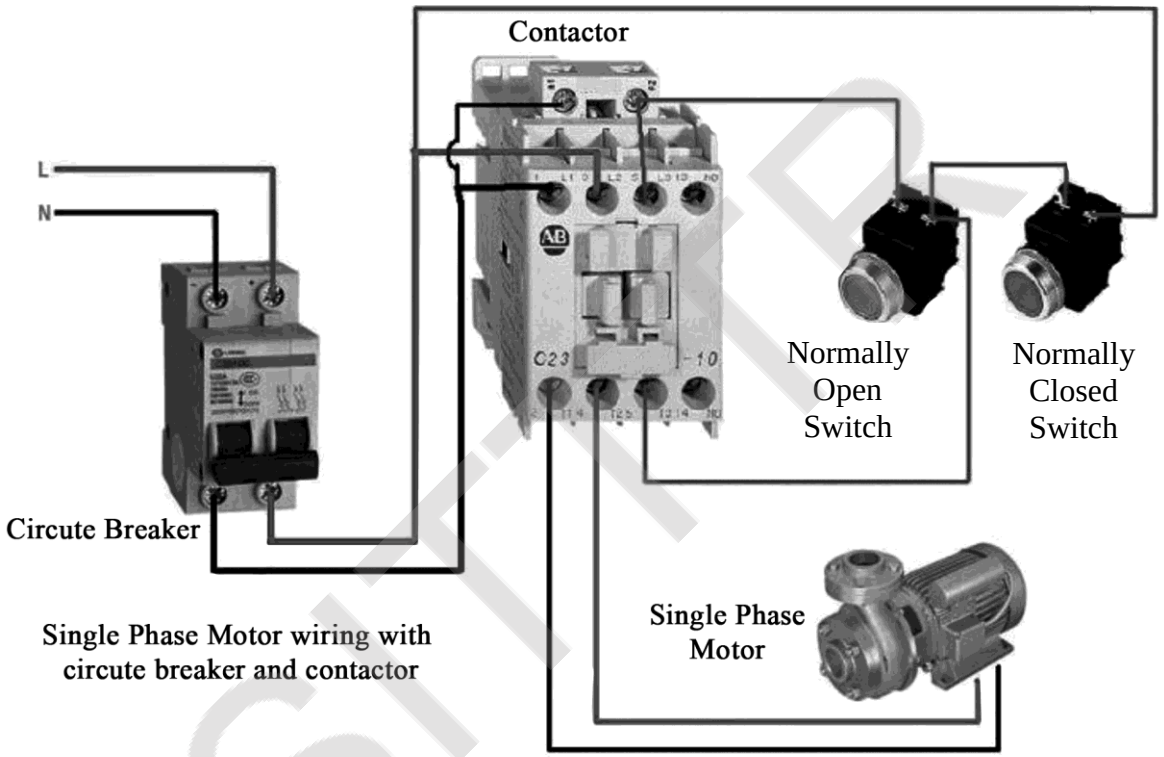
Procedure

1. Draw layout on the wiring board.
2. According to the layout, fix 20mm conduit on the board using saddles.
3. Draw cables through the conduit and connect as per connection diagram.
4. Fix lamp holder and switches on round blocks.
5. Give the specified supply and verify lamp status for different positions of switches.

Result :

Exercise No.3 Date:

SINGLE PHASE MOTOR STARTER WIRING DIAGRAM



Exercise No.3 Date:

SINGLE PHASE MOTOR STARTER WIRING DIAGRAM

Aim:-

To study the wiring diagram of a single phase motor with a DOL starter.

Tools required:

Sl No	Name of tool &specification	Quantity	Remarks
1	Screw driver 200mm	1	
2	Connector screw driver 150mm	1	
3	Line tester 500V(neon)	1	
4	Cutting pliers 150mm(insulated)	1	
5	Combination pliers 150mm	1	

Materials required

Sl.No.	Name of materials & specifications	Quantity	Remarks

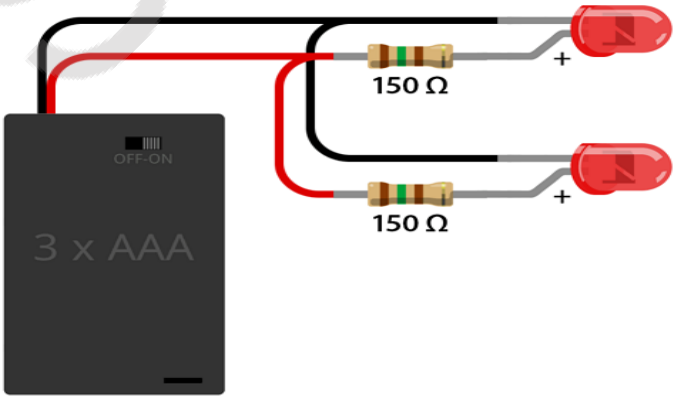
Procedure:-

1. Connections were made as per connection diagram.
2. Check the circuit for continuity.
3. Given the supply to the circuit after checking.
4. Finished the work neatly and correctly.

Result:-

Exercise No.4 Date:

SOLDERING & DE- SOLDERING



Exercise No.4 Date:

SOLDERING & DE- SOLDERING

Aim :

To practice soldering and de-soldering for the given electronic circuit using a soldering iron.

Apparatus required:-

Sl no	Name of tool &specification	Quantity	Remarks
1	Soldering iron (10W or 35W)	1No	
2	Solder (60/40grade)	1	
3	Flux	1	
4	Connecting wires	1	
5	Lead	1	
6	Nose plier	1	

Procedure:-

1. Clean the terminals of LED and connecting wires.
2. Clean the tips of soldering iron before heating.
3. Heat the soldering iron and apply solder to the tip as soon as it is hot to melt on it.
4. Solder the connections using soldering iron tip at joints.
5. Trim excess component leads with side cutter.
6. Connect the supply and observe the result.
7. Dismantle the components using soldering iron and clean the components.

Result:-

VIVA SAMPLE QUESTIONS

CARPENTRY

1. What is mean by seasoning of wood? What are the types?
2. Classify the tools used in carpentry section with examples?
3. What are the different types of planes used in carpentry?
4. Name different wood working machines?
5. Name different parts of a jack plane?
6. What are the types of chisels used in carpentry shop?
7. What type of saw is used to cut wood along the grain?
8. What are the different types of defects in wood?
9. What are the different types of work holding devices used in carpentry?
10. Name different types of saws used in carpentry?

FITTING

1. What are the different types of files used in a fitting shop?
2. What are the different measuring tools used in a fitting shop?
3. Name different types of hammers used?
4. What are the tools used to make internal and external threads in a fitting shop?
5. What are the different types of filing methods?
6. Name different types of chisels used?
7. How a hack saw blade is specified?
8. How callipers are classified?
9. Name different types of punches used in fitting shop?
10. What is a surface plate? For what purpose it is used?

WELDING

1. What are the safety precautions to be taken for welding in a shop?
2. Name different types of welding methods?
3. What is mean by arc welding? Name the tools and accessories required for arc welding?
4. What is the function of an electrode? How an electrode is specified?
5. What are the defects in welding?
6. What is the function of a chipping hammer?
7. Name different types of welding positions?

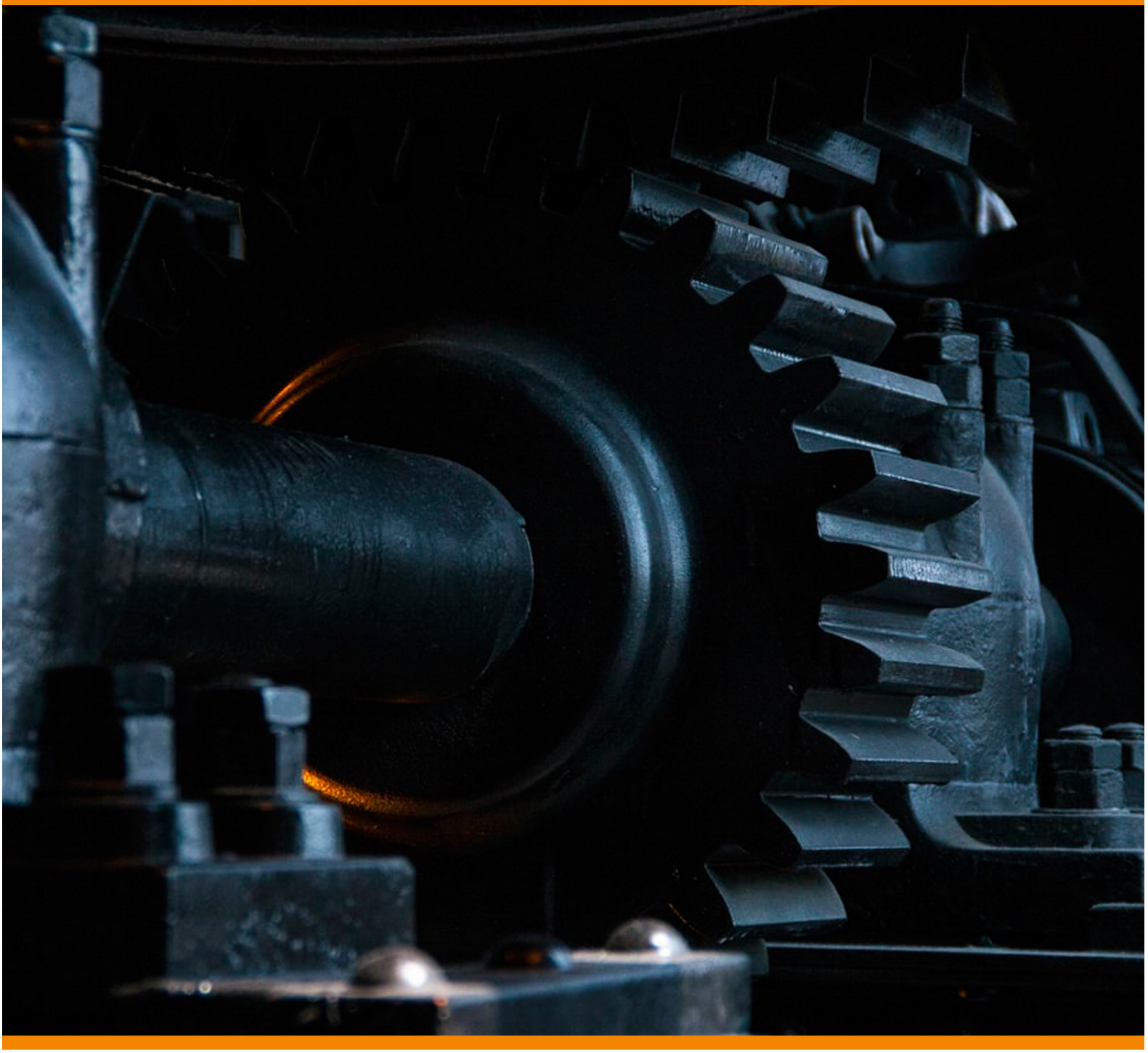
8. What is the purpose of flux coating on welding electrodes?
9. What type of transformer is used in arc welding machine?
10. Name different types of welded joints?

SHEET METAL

1. Name different measuring and marking tools used in sheet metal section?
2. What is the purpose of a stake?
3. What are the different types of stakes used?
4. What do you mean by Galvanisation?
5. What are the different types of metal sheets available? How a sheet is distinguished from a plate?
6. What are the various methods available for joining sheet metals together?
7. What is the purpose of a trammel point?
8. What do you mean by hems and seams?
9. What is mean by SWG?
10. What are the types of striking tools used in sheet metal operations?

ELECTRICAL WIRING/SOLDERING

1. Name the safety devices used to protect the electric circuits from overload?
2. Differentiate between fuse and a circuit breaker
3. What are the safety precautions to be taken in an electrical workshop?
4. Name different wiring tools?
5. What are the different types of switches used?
6. What is soldering? What are the tools required for soldering operation?
7. How induction motors are classified for producing phase difference between two windings?
8. What is the function of flux in soldering?
9. What is mean by wave soldering?
10. What are the different measuring instruments used in electrical workshop



Govt. of Kerala

Department of Technical Education

State Institute of Technical Teachers' Training & Research

(SITTTR), Kalamassery